INDIAN TOXICOLOGY.

F. N. WINDSOR.

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BY

F. N. WINDSOR,

CAPTAIN, I.M.S., M.B., M.R.C.S., B.A., B.SC.,

Chemical Analyst and Bacteriologist to the Government of Burmah.

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PREFACE.

In this book an attempt has been made to describe fully those poisons which are used in India, and to omit such as are only Toxicological curiosities. This plan has been pursued in the hope that the contents may be of practical use to both medical men and students in this country. The latter, in view of their final examination, will probably be obliged to consult larger text-books for information about European Toxicology, although this will prove of no use to them in their future career in India.

F. N. WINDSOR.

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INDIAN TOXICOLOGY.

CHAPTER I.

Introductory.

Toxicology is the science which treats of poisons :—

1. Their physical and chemical properties.

2. Their physiological and chemical action on the animal economy, and the pathological changes they induce.

3. Their recognition by :—

(*a*) Signs and symptoms during life.

(*b*) Post-mortem signs.

(*c*) Chemical and physical examination.

4. The treatment of the physiological and pathological conditions they induce.

Definition of Poison.—A poison is a substance which, if received into the cavities, tissues or blood of an animal, will, even if present in a reasonably small quantity, cause a harmful physiological or pathological condition by chemical influence.

Thus, mechanical irritants, such as powdered glass, are not poisons. Certain non-poisons, such as common salt and magnesium sulphate will, in large doses, cause poisonous symptoms.

Legally, the bearing and limitation of the term "poison" are dealt with in the following sections, Indian Penal Code :—284, 299, 304A, 324, 326 and 328.

The poisons commonly used in India are Arsenic, Mercury, Opium, Dhatura, Aconite, Indian Hemp and Oleander. More rarely met with are Strychnia, Morphia, Cocaine and Plumbago. Copper, Lead, Phosphorus are almost curiosities as poisons. Deaths from alcoholic poisoning are probably also rare.

The action of a poison gives rise to physiological and pathological results :—

(*a*) Local.
(*b*) Remote.
(*c*) Both local and remote.

In arsenic poisoning the irritation and inflammation of the gastro-intestinal tract are *local effects*, while the succeeding shock and prostration are *remote*. In strychnine poisoning the effects are all *remote*.

The remote effects are usually due to affection of the central nervous system.

Factors modifying the action are :—

1. Method of administration—
   (*a*) Endermic.
   (*b*) Hypodermic.
   (*c*) Intra-muscular.
   (*d*) By the natural orifices.
2. Physical state ; namely, as a solid or as a solution, and if the former, the state of division. A coarsely ground solid is the most inert form.

3. Quantity ; for poisons have different actions according to the dose, and some in non-poisonous repeated doses are cumulative.
4. Personal factors ; such as state of health, age and size, idiosyncrasy, habit and amount of food present in the stomach.
5. Presence of another poison or drug.

CHAPTER II.

Recognition of Poisoning.

Signs and Symptoms Causing Suspicion :—

(*a*) Very sudden onset of illness in a healthy person. This refers naturally only to acute poisoning.

(*b*) Rapid development and termination by recovery or death. Certain poisons, however, may leave sequelæ of long duration.

(*c*) Close relation of the time of onset to the taking of food or drink. Practically all poisons take effect within an hour of ingestion.

(*d*) Multiple occurrence. Several persons may have been under the same conditions or have eaten the same food.

(*e*) Peculiar odour of the breath or abnormality in the excreta.

Certain diseases resemble poisoning in some of their symptoms, thus :—

Irritant Poisoning must be distinguished from Cholera, Gastritis or Gastric Ulcer, Dysentery, Enteritis and Peritonitis.

Narcotic Poisoning may be confused with Apoplexy, Uræmia or Diabetic Coma.

A Cardiac Poison may cause symptoms confusable with Heart Disease.

Convulsives cause results not unlike those of Tetanus or Hydrophobia.

Confirmation of the Suspicion :—

(1) By analysis of food or drink.
(2) By analysis of excreta or vomited matter.
(3) By post-mortem examination.
(4) By analysis of viscera and their contents.

Analysis may fail to detect poison in consequence of:—

(1) Elimination of poison by vomiting, purging or lavage.
(2) Destruction of poison by putrefactive change.
(3) Absence of a reliable test.
(4) Insufficiency or wrong selection of material.
(5) Negligence or want of skill of the examiner.

Post-mortem Signs are only useful in poisoning by corrosive, irritant or odorous substances or because of particles found in the hollow viscera or because affording evidence against poisoning, *e.g.*, the presence of scybala in the colon or rectum excludes irritant poisoning.

Conduction of a "Post-mortem" on a Suspected Case of Poisoning :—

1. Examination of surroundings, clothing, surface of the body and natural orifices ; in the neighbourhood may be found vomit or excreta, fragments of food or vessels in which suspicious material may be present.

On the clothing or surface of the body may be stains or marks of vomit, of fæces or of the poison itself ; or wounds may be detected.

In a natural orifice may be present poisonous material or signs of its having been present :—the mouth, rectum

and vagina in certain cases show signs of great value ; there may be a characteristic odour at the mouth.

2. After opening the body and examination of parts *in situ*, certain viscera must be removed :—

(*a*) The stomach, by placing a double ligature at œsophagus and duodenum and cutting between.

(*b*) Upper part of small intestine, two feet or so in length in a similar way.

(*c*) Liver, kidneys, spleen.

(*d*) Urine, by using a clean catheter.

The stomach having been placed in a clean dish, should be opened along the lesser curvature. The contents having escaped, the fingers passing over the mucous membrane may detect grit or particles ; such material should be removed with the point of a knife and placed in a clean phial. The open viscus can now be examined in a clean flat vessel, and its mucous membrane wiped with an absorbent wool swab and distilled water. Any peculiar smell must be noted.

Hyperæmia of the cardiac end and greater curvature suggests irritant poisoning ; in disease the redness is more general, although in intense " irritation " the whole mucous membrane may be inflamed. The discolouration of putrefaction is most marked on the posterior wall.

Softening and Corrosion are very characteristic of corrosive poisoning or the action of strong irritants, and especially so when affecting the cardiac end and greater curvature. Corrosives also affect the mouth and gullet, but irritants do not.

Post-mortem softening affects chiefly the posterior wall and extends to the muscular coat, without a separation of mucosa, and the softened patch is not surrounded by an inflamed area as is corrosion.

Ulceration has the same signification and site as corrosion. A pathic gastric ulcer is frequently on the lesser curvature with firm and indurated edges, while that due to corrosion has a soft friable margin with the neighbouring mucosa also softened.

Perforation is a further extension of the last process, but is rare in poisoning.

Hæmorrhagic Patches are often present in corrosive and irritant poisoning.

Discolouration or Blackening may be due to sulphuric acid poisoning or to staining by fruit juice. These conditions are readily distinguishable. Green colouration may be due to copper poisoning, and yellow to arsenic.

The Intestines may show hyperæmia or inflammation from irritant poisoning, but softening or ulceration from this cause are rare. The contents of the large intestine must be observed, since the presence of solid matter negatives irritant poisoning.

The Stomach Contents must be broken up between finger and thumb, when gritty particles will be felt and removed.

Any peculiar fragments must be removed, washed and examined, and all seeds, etc., should be similarly treated ; by this proceeding particles of white or yellow arsenic, pieces of aconite root, fragments of nux vomica seeds,

dhatura seeds or fragments thereof, and bhang may be at once recognised ; the microscopic appearances of fragments of dhatura and bhang are typical (see pp. 69 & 82).

In opium-poisoning there is often a characteristic smell or presence of viscid brown matter ; some of this mixed with distilled water and filtered so as to give about half a test-tube-full of clear liquid, which can be rendered acid with a drop or two of dilute hydrochloric, may be tested for meconic acid (see p. 22).

The Contents of the Small Intestine should be similarly examined.

Mouth and Pharynx must be examined for inflammation, corrosion or ulceration and the presence of foreign matter.

The Œsophagus must be removed after examination of lungs and heart, cut open and examined.

The Brain in opium-poisoning is usually much congested, as are also the lungs.

Preservation and Despatch of Material for Chemical Analysis.—This is the duty of the person performing the *post-mortem*, and should be carefully and correctly done.

Despatch of Viscera should be in wide-necked bottles, so that material may be readily extracted even though hardened by spirit.

One bottle contains stomach and its contents ; a second, small intestine and its contents ; a third, liver not less

than 16 ounces in weight, one kidney, and the whole or a large piece of spleen ; a fourth, urine ; a fifth, a sample of the preservative used ; any particles, etc., which have been removed must be packed appropriately and sent dry.

If a sample of the preservative be not examined, it may be urged in a court of law that poison was introduced in that fluid ; arsenic in solution has been found in such a sample of spirit, and corrosive sublimate in a sample of brine sent with viscera preserved in these liquids. Before bottling, the solid viscera should be weighed intact and the portion sent also weighed, while any fluid material should be measured.

To the contents of the first three bottles rectified spirit* should be added so that the material may be amply covered, whatever the position of the bottle ; but in suspected alcoholic poisoning a saturated solution of common table salt should be used. After securely corking and sealing, accurate labels must be affixed giving the exact nature of contents and name of deceased, with serial numbers or letters agreeing with the invoice list of articles ; the packer should sign each label.

Despatch of other Material, such as vomit, excreta or food and drink, should be carried out in the same way, but spirit need only be added to decomposable matter.

Clothing which is stained should be sent intact and may be made into a bundle and enclosed in a sealed cloth

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* Methylated Spirit because it often contains Caoutchoucine should not be used.

wrapper. Bottles to be sent by post or rail must be carefully packed in stout boxes with a sufficiency of cotton wool to prevent breakage. And the material of different cases must be packed in separate boxes.

An Invoice List of articles must be prepared agreeing with the labelling on the vessels, etc.

The Opinion of the Examiner as to cause of death and a complete *post-mortem* report, must be furnished.

The Reasons for the Precautions above indicated are (*a*) poison found in the solid viscera can only have got there by the blood stream, so that if thus detected, when no contamination by stomach contents, etc., has occurred, positive proof is afforded that poison was absorbed during life, and moreover when the vital powers were active ; (*b*) certain vegetable poisons can only be readily detected in the contents of the alimentary canal, and mixing with this material, of blood and juices, embarasses the examination and may cause loss of the poison in purifying processes.

CHAPTER III.

The Analysis and Routine Examination for Poison.

(*a*) Verification of seals on boxes, parcels, vessels, etc., and comparison of labels with the invoice list of material said to have been sent ;

(*b*) Opening bottles, etc., and placing contents in separate shallow porcelain basins ;

(*c*) Visual inspection (smell at this time is probably of no help); careful examination of the mucous membrane of the stomach, after draining away all fluid, may shew particles of white or yellow arsenic, fragments of seeds or roots, or the brown viscid remains of opium.

Yellow Patches in the mucous membrane are practically always due to a deposit of yellow arsenic in the epithelial cells and are caused by the action of sulphuretted hydrogen upon the arsenic which has been absorbed by those cells during life.

Irritant or Corrosive poisoning is negatived by a pale normal mucous membrane free from signs of inflammation, ulceration or hæmorrhage.

Arsenic or Mercury poisoning are negatived by advanced putrefaction or the presence of maggots.

Particles, not of ordinary food, should be removed with a knife point and placed on blotting paper to dry, or on a slide in little glycerine for microscopical examination. Opium-like material can be treated as described on page 22, but it will be necessary after filtration to evaporate to half the bulk on a water bath, to drive off spirit and then refilter and test for meconic acid.

Gritty Particles may be white or yellow arsenic. These after drying on blotting paper should be dropped into a narrow warm test tube, which has been thoroughly dried by heat. The closed end of the tube must then be strongly heated in Bunsen or spirit flame, when the arsenic compounds will volatilize and deposit as a haze about half an inch higher up where the glass is cooler; this haze under a $\frac{1}{4}$-inch or $\frac{1}{6}$-inch objective is found to consist of innumerable complete and truncated colourless octahedral crystals. This result is diagnostic.

White gritty particles of organic matter are not infrequently present on the mucous membrane; these can be squashed under the knife blade, and heated in the test tube, blacken with a deposit of brown oily matter on the cooler part of the glass.

A Microscopical Examination should be made of a little of the stomach contents, rubbed up on a slide with a drop or two of glycerine; fragments of dhatura seeds and bhang may thus be recognized.

Weighing and Measuring, according to the nature of material, should next be carried out before proceeding to analyze; each portion removed for examina-

tion should also be estimated so that a quantitative result can be arrived at, if required. It will be evident from previous remarks on the phenomenon of poisoning, that the quantitative determination of a poison in viscera is of minor value ; truly if a lethal amount be extracted it means that almost certainly death was due to that poison, and especially is this the case with minerals, where the element in question is naturally unchanged ; on the other hand if less than a lethal dose be extracted, it is no evidence against fatal poisoning, for in the case of minerals, death may have resulted from union with tissues that have not been supplied to the analyst, and in the case of vegetable poison, that portion which has killed is probably not recoverable, since it has entered into chemical union with protoplasmic molecules and lost its original characteristics, *the amount which is recovered having had no influence whatever.*

A consideration of a case, where precisely a lethal dose of morphia and no more has caused death, will make this important point clear. Here, little morphia will be found in the contents of the alimentary canal, for it must nearly all have been absorbed in order to cause the effect. Little will be found in the blood, for it must almost all have been removed from the blood by the protoplasm of the tissues it unites with. Finally, very little will be found in the liver, spleen, kidneys or urine, for the nervous tissue required practically all the poison for death to have occurred.

Nevertheless in courts of law considerable stress is often laid upon the amount of poison actually recovered.

Chemical Analysis of Viscera and Products of the Body.

If any clue or indication of the nature of the poison exists, this should be followed up at once. If not, then the following routine may be adopted.

Testing for Mineral Irritants.

Since there is no clear indication of such poison, and since if a mineral be present it will almost certainly be detectable in the solid viscera, while it is extremely doubtful if vegetable poison is detectable in them when *blood free*, at this stage the examination should be limited to these organs.

A portion or the whole of spleen and kidney and a piece of liver should be squeezed dry in muslin and subjected to Reinsch's test while the exudate is retained.

Reinsch's Test will disclose the presence of Arsenic, Antimony, Mercury and Bismuth.

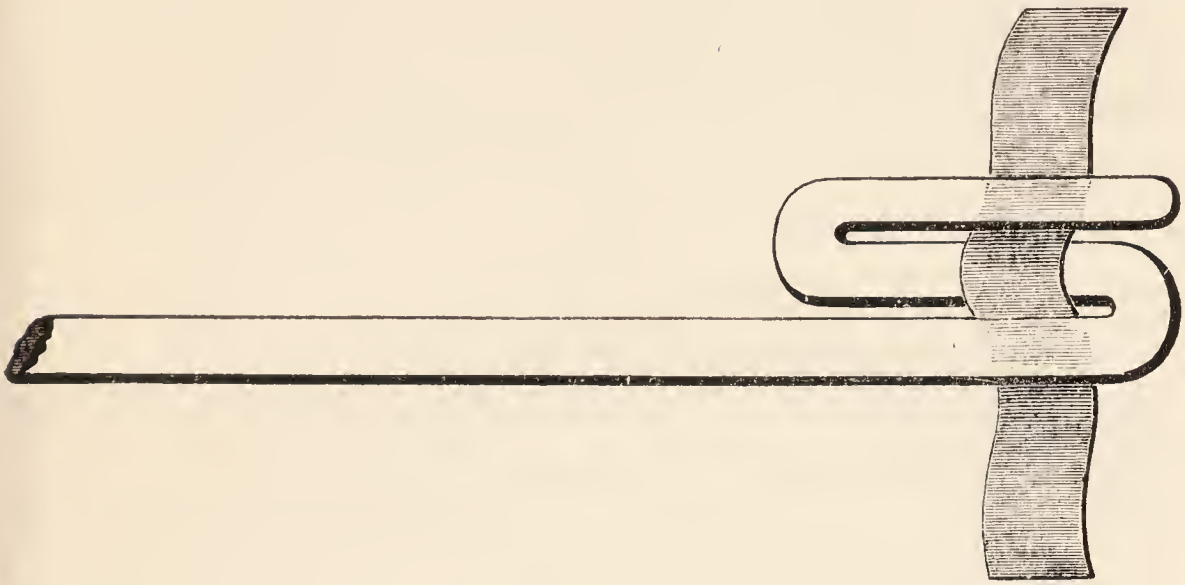
A large porcelain basin is to be half filled with pure hydrochloric acid (strength 1 in 6) and placed on a proper support over a Bunsen or spirit flame.

A baked clay cylinder or flower pot with the bottom knocked out and a piece chipped out of the edge to admit air, does well enough to support the basin.

A slip of pure copper foil should be immersed in the boiling acid bath after cleansing the surface by dipping into strong nitric acid and washing in water.

The fixing of the copper to a glass rod facilitates manipulations and enables the bath to be stirred. The

diagram shows a simple and convenient method of doing this.



MADRAS LABORATORY METHOD OF ATTACHING COPPER TO ROD.

If after quarter of an hour's boiling the copper remains clean and bright, then the re-agents may be declared arsenic or antimony free. This precaution should never be omitted. The fragments of solid viscera should now be introduced and stirred up with the hot acid.

A positive reaction is shown by the copper surface becoming grey or black if ARSENIC, ANTIMONY or BISMUTH, and silvery if MERCURY is present. This may occur in a few minutes or be delayed for an hour or more, but will not be complete until the spirit is dispersed. The discoloured slip must be washed under a gentle stream of water, detached from the rod and dried by pressing between folds of blotting paper ; then it can be folded to occupy a small compass, dropped into a dry warm test-tube and heated as before described on page 12.

Arsenic is shewn by the octahedral crystals before mentioned forming in a film above the heated end.

Mercury will give a much fainter film higher up the tube, which, under the microscope is seen to consist of minute globules of the metal, shining and opaque.

Antimony with greater heat will afford a film of the amorphous oxide.

Bismuth will not form a sublimate.

If one of these minerals be thus shewn to be present, a portion of each of the contents of the other vessels received should be subjected also to Reinsch's test. Before this is done to the stomach and intestines, all the fluid should be filtered off and set aside to test for opium which is not infrequently given along with the irritant, for the solid residue and organs themselves will amply serve to show the presence or absence of the metal, while the opium if present will be probably all dissolved in the preservative spirit and detectable in it.

Earth and Ashes are often sent for examination having been collected from the supposed site of vomiting or purging. This contains carbonates which, with acid, give a troublesome frothing or perhaps nitrates or chlorates which will cause solution of the copper. If this is the case, Marsh's test should be employed with a hydrochloric acid extract of the material evaporated to a small bulk.

If none of these metals be detected and there is a likelihood of irritant poisoning, it is possible that some other was the agent, such as **Lead, Tin, Copper or Zinc.**

Filter the fluid from the blank Reinsch's test, while hot, into a porcelain basin and evaporate down to a small bulk,

transfer this to an incinerating capsule and evaporate to dryness. Then incinerate completely in a blow pipe flame, and when cool, dissolve the residue in half a test-tube of boiling distilled water, filtering this while hot into a test-tube and then cooling.

Sulphuretted hydrogen passed through the fluid will give a black precipitate, if lead, copper or tin be present, and white if zinc. The two former only need be considered (see pp. 55 & 52), and since the latter of these may well be derived from the copper Foil, the original material must be tested for this element.

Quantitative Estimation of Metals will rarely be required, and need not be described at length.

In most cases organic matter must be destroyed by boiling with potassium chlorate and hydrochloric acid, by nitric acid or by incineration. The latter obviously will not do for the volatile arsenic compounds. For the estimation of small quantities of arsenic a modification of Marsh's test is used and the strength of the metallic deposit compared with prepared standards. The electrolytic method is now generally employed for evolution of the arseniuretted hydrogen. A simple method of estimating arsenic is described on page 46.

Testing for Vegetable Poisons.

The examination for these cannot be carried out with material which has been subjected to Reinsch's test, etc., but since after the extraction of vegetable active principles, the residue is available for an analysis of minerals, unless such have been detected in the foregoing investigation, a

search for poisonous glucosides and alkaloids should now be pursued, by a modification of Stas' process and the employment of a physiological test before the final extraction by special solvents.

Separation and Detection of Vegetable Poison.

The stomach and piece of intestine must be chopped small with scissors and, together with the fluid contents and preservative, are to be placed in a beaker or flask with half a pint or so of rectified spirit and so digested for at least 24 hours. The vessel, for two or three hours of this time, should stand in a basin of hot water. Other material such as vomited matter or suspected food, should be treated separately in the same way. After this digestion the material is filtered, the solid matter being well squeezed in muslin to extract all fluid, soaked again for 24 hours in rectified spirit and again squeezed dry over a filter.

The two filtrates are to be mixed and evaporated to a thick syrup on an open water bath. This extract is now stirred up with hot absolute alcohol, refiltered, and again evaporated to a pasty condition. In this way a quantity of gummy and fatty matter is removed, while alkaloids and glucosides are retained. The paste is now rubbed up with an ounce of distilled water.

The Physiological Test can next be employed on a frog and eye of a cat. One drachm of the watery mixture, unfiltered, is injected with a hypodermic syringe under the skin of a frog. It is necessary to have an assistant to hold the animal in a cloth and stretch out one

hind leg while covering the anus with a fold of the cloth. The needle should be entered under the skin at the back of the thigh, and pushed up into the region of the dorsal lymph sac. The animal can then be placed under a beaker or glass jar and observed.

Poisons Causing Characteristic Signs in a Frog :—

Strychnine causes, with a weak dose, tetanic convulsions, readily induced by tapping the skin ; a strong dose causes, almost at once, absolute rigidity in the extended position, so that the animal can be held out like a rod. The heart is arrested in systole.

Aconitine causes paralysis of the voluntary muscles and vagus nerve by acting on the nerve terminations. The animal becomes limp and flaccid with distended abdomen and dilated pupils. The heart beats rapidly and irregularly, so that the ventricle does not relax and fill with blood in diastole. The lungs are enormously distended with air. Pinching the sciatic nerve does not cause contraction of the gastrocnemii.

Thevetin from *yellow oleander* seeds causes convulsive spasms, but no tetanic condition. Stimulation causes violent leaping. Later, the animal fails to balance on its feet and falls over on to its back. The heart stops with auricles, and venous system intensely engorged, but with a contracted and bloodless ventricle. Stimulation of the sciatic nerve causes energetic twitching of the whole leg.

Cocaine causes paralysis of the voluntary muscles, the animal being limp and flaccid, but with no marked

abdominal distension. The heart beats slowly with a long interval between the beats, and filling completely in diastole. Stimulation of the sciatic nerve causes no contraction of the gastrocnemii. The lungs are not distended.

Opium in small doses has no marked effect. A watery solution from an alcoholic extract of five grains causes a preliminary lethargy, followed in about ten minutes by rhythmic tonic spasms or jerks of the hind limbs, which in the intervals are extended and flaccid. Pinching a foot at once causes a spasm. The heart beats feebly and slowly and becomes arrested in diastole. Morphine, half a grain, causes an increased reflex muscular activity in the form of leaping, and later, after some hours, a similar spasmodic condition of the hind limbs to that of opium-poisoning. Quarter of a grain has little or no effect.

Neither opium nor morphine cause the absolute rigidity of strychnine.

Oleander Nerium or *red oleander* by the action of the glucosides *neriodorin* and *karabin*, causes death with no definite characteristic signs. The animal becomes limp and powerless, and the heart's beat is found to be weak, but not slowed. Stimulation of the sciatic nerve causes active contraction of the gastrocnemii.

Direct application of the extract to the heart caused marked weakening of force in the beat, while the application of *digitalin* caused very great increase in force, with slowing.

Poisons Causing Mydriasis are *dhatura*, *belladonna* and *hyoscyamus*. A few drops from the watery

mixture after the cleansing alcoholic extraction, may be dropped into a cat's eye. A kid is more easily handled, but does not react so well as a carnivorous animal. A very minute dose of the above poisons will cause dilatation of the pupil in half to one hour's time. This is best seen by holding up in front of a strong light, when the unaffected pupil contracts to a pin's point, the other remaining dilated.

DETECTION OF OPIUM.

If there is a possibility of opium being present it must now be tested for.

Six drops of glacial acetic acid are to be added to the seven drachms remaining of the watery mixture and, after stirring, this should be filtered.

If opium is the only suspected poison or if the rough preliminary analysis showed it to be present, the whole filtrate is taken to test for meconic acid and morphia the presence of which is proof of opium.

If there be only a possibility, then half must be reserved for further analysis. A solution of subacetate of lead is to be added, drop by drop, to the suspected liquid until no further precipitate falls. This precipitate is lead meconate. If there be no precipitate, opium is not present, but morphia may be, for morphia in opium is present as meconate. After boiling the mixture, the precipitate by standing or centrifugalizing is separated, and the supernatant fluid poured on to a filter and the filtrate preserved. Distilled water is shaken up with the precipitate which is again separated and rewashed, but now the supernatent fluid need not be reserved. If this fluid gives no red colour with ferric perchloride solution, then

all the acetic acid has been washed away, and (*a*) sulphuretted hydrogen is to be passed through a suspension of the precipitate in distilled water, while (*b*) to the reserved filtrate dilute sulphuric acid is to be added till no further precipitate falls.

The sulphuretted hydrogen decomposes the precipitate of lead meconate into lead sulphide and meconic acid. The dilute sulphuric acid precipitates lead sulphate, leaving in solution morphine sulphate and free sulphuric and acetic acids.

The black sulphide and white sulphate of lead are now separated by the centrifuge or filtering from the solutions respectively of meconic acid and morphia, and the clear fluids evaporated down on water-baths in separate basins to a bulk of about two drachms.

Meconic Acid is detected by adding two drops of liquor ferri perchloride (half B. P. strength) to the concentrated liquid from (*a*) process, when cold. A blood red colour shews its presence in the form of meconate of iron. A little dilute hydrochloric acid bleaches the red of acetate of iron, but not the meconate. More hydrochloric acid will also bleach the iron meconate, but a solution of perchloride of mercury will not. Strong hydrochloric acid, however, will bleach the red meconate at once. Mercuric chloride solution does not bleach the red acetate or meconate, but will so affect the sulphocyanide which, however, cannot be present after the extraction process. Antipyrin also gives a blood red colour with ferric chloride which, however, is bleached by dilute sulphuric acid. If the quantity of meconic acid be a mere trace, then only an orange colour is caused by the

addition of ferric chloride. If this orange solution be boiled the colour deepens, as does a solution of ferric chloride, but unlike the latter will not be bleached by four or five drops of dilute nitric acid (strength 1 in 6). Similar quantities of one or two drachms should be used and allowed to stand, after addition of the nitric acid, for 24 hours.

Morphia:—The clear liquid after separation of all lead by sulphuric acid and subsequent evaporation as above indicated in (*b*) process, is placed in a separator and shaken up with sulphuric ether of about double its volume, to remove colouring matter and other impurities. After the ether has quite separated, the watery solution is run off into another separator and rendered just alkaline, with sodium carbonate solution. This is shewn by a bit of red litmus paper becoming blue.

Porphyroxin Test:—Sulphuric ether is added and shaken up with this alkaline fluid, and, after separation, removed with a pipette and allowed to evaporate spontaneously in a small porcelain dish. To the dry residue a few drops of dilute hydrochloric acid are to be added, and the dish heated over the flame, when a rose pink colour shows the presence of one of the opium constituents, but which one is not exactly known.

Morphia is soluble in ordinary trade acetic ether (acetaldehyde), in amyl alcohol and in a mixture of two parts ether and one part absolute alcohol. The amyl alcohol solvent is generally used, and must be added hot in quantity of an ounce or ounce and a half to the alkaline liquid in the separator, and shaken up with it vigorously for about quarter of an hour or longer : after separation

the alcoholic top layer is removed to an evaporating basin, preferably of glass, and placed on a water-bath at a temperature below boiling point. An open water-bath ensures the temperature not rising too high. The *alkaloid morphine* will be thus left practically pure and may be scraped up with a knife blade, and subjected to chemical *morphine tests*—*

(1) Pure nitric acid gives an orange colour unchanged by sodium thiosulphate. This test is best performed on a glass slide on white paper, by applying a drop of the acid on a glass rod to a little of the solid morphine.

(2) Dissolve the solid in a few drops of very dilute acetic acid, and evaporate to dryness. The acetate of morphia is now present and is soluble in distilled water :—

To a drop of this solution on a glass slide add a drop of dilute ammonia, a fine precipitate of the alkaloid falls which, under the microscope, is seen to consist of fusiform or prismatic crystals in pairs, sheaves, rosettes or crosses.

Drops of ammonia should be added to the rest of the solution till it is alkaline. This precipitates pure morphine which sinks to the bottom, so that with a fine pipette all the supernatant fluid can be removed. A little distilled water is to be added, agitated with the precipitate and again removed with the pipette, and the crystals dried on a water-bath. A drop of nearly neutral ferric chloride solution turns blue when a little of the morphine is added on the point of a spatula. A solution of iodic acid turns yellow when morphine is added, from liberation of

* If the quantity of morphine is very small test (2) will probably fail.

iodine ; if chloroform be shaken up with this it dissolves the iodine, becoming rose pink, and sinks to the bottom of the test tube.

The nitric acid test can be reapplied to the pure precipitated alkaloid.

Separation of other vegetable Poisons. Stas-Otto Process.

The *watery* mixture previously made from the alcoholic extract (see page 18) must be acidified, a few small crystals of tartaric acid being used if aconite, and a few drops of glacial acetic acid if any other poison is suspected. After stirring and standing for half an hour on a hot water-bath this liquid is to be filtered into a separator, and vigorously shaken up with twice its volume of sulphuric ether. This will remove colouring matter and any fat that may be present. The supernatant ether is to be separated and retained.*

The watery solution is now to be rendered alkaline with sodium carbonate, and well shaken up with a mixture of sulphuric ether and chloroform of about three times its bulk, and with sufficient of the latter to ensure sinking of the mixture below the watery layer. The shaking must be repeated two or three times and then, after standing for 24 hours, the chloroform-ether mixture is to be run into a glass basin, and allowed to evaporate at a temperature not over 65°C. The use of a centrifuge will avoid the long standing and in a few minutes separate the

* Although as a rule the acid compounds of the alkaloids are insoluble in *ether*, yet there are exceptions which, however, are rarely met with in India. In this connection see note to page 77.

liquids perfectly. The alkaloids themselves, formed on adding the alkali, are hardly soluble in water but are readily soluble as a rule in ether and chloroform.

After evaporation, any alkaloid present will be left almost if not quite pure and in a crystalline form.

A little of this residue should be scraped up with a knife blade and reserved for chemical tests about to be described, while the remainder should be dissolved in two or three drops of very dilute acetic acid. A little of this solution should be applied to the tongue and by means of a glass rod and a piece of glass on black paper traces subjected to the group tests for alkaloids. The group re-agents are iodine in potassium iodide solution, mercuric potassium iodide, gold chloride, phosphomolybdic acid, silico-tungstic acid and zinc iodate solutions. These give precipitates which, in some cases, are characteristic. The tongue will give an indication with aconite, strychnine and cocaine. The eye will be used for atropin, dhaturine, etc., as already described. The frog may be again used, for now the material injected will be much purer.

Glucosides.—These cannot be separated as can the alkaloids, for they are, as a class, insoluble in ether and chloroform or nearly so.

They will be contained, however, in the extract obtained with hot absolute alcohol (see page 18) and some of this must be directly tested for their presence. A drop of strong sulphuric acid will give characteristic colour reactions with salicin, thevetin, neriodorin, karabin, and caustic potash with plumbagin.

Physiological tests must also be employed.

If no vegetable poison be thus detected, the **Juices** from the **Solid Viscera, also Urine, Vomited or Dejected Matters**, must be similarly separately subjected to extraction and may reveal a poison which had perhaps all been removed from the alimentary canal.

Lastly, the residue of stomach, etc., from the alcoholic extractions must, if there is any evidence of **Irritant Poisoning**, be subjected to Reinsch's and other tests as already described.

Examination of Material other than Viscera or Body Products :—

Food may be treated in the same way as stomach contents or vomited matter, inspection often revealing the nature of the poison.

Vegetable matter may be identified by physical signs or by extracting and testing the active principle by physiological or chemical means.

Drugs are in the form of pills, powders or masses :

Pills are usually entirely vegetable, and test may be conveniently employed, or an alcoholic extract treated to tests. Powders are often obviously mineral in nature, but a systematic qualitative analysis is usually necessary for identification.

Qualitative Analysis—

(1) Physical characters of taste, smell, appearance, etc.

(2) Dry Examination. A liquid can be evaporated to dryness to obtain a solid residue.

(*a*) Heat a little in the bottom of a dry test-tube.

Sublimation occurs with Ammonium Compounds, Arsenic, Mercuric Chloride and other Mercury salts, Oxalic Acid and Benzoic Acid. The sublimate must be examined microscopically.

Charring shews the presence of a "Carbon Compound."

Change of colour to yellow shews Zinc.

Water will be given off from a Hydrated Salt or gas from Oxalic Acid.

No change shews a mineral.

(*b*) *If charring* has occurred, a little of the material should be incinerated on Platinum Foil and the residue, if any, examined for minerals.

(*c*) If mineral, a little should be moistened with strong Hydrochloric Acid and in a Platinum Wire Loop held in the edge of a colourless flame. Sodium Salts give a brilliant *Yellow* flame, Potassium a delicate *Violet*, Lithium *Crimson*, Calcium *Orange Red*, Strontium *Bright Red*, and Barium *Green*.

(*d*) If the mineral give no coloured flame a little Borax may be fused in a Platinum Loop, dipped into the Salt and again fused in the oxidizing part of a Bunsen or blowpipe flame. Iron salts give a *Yellow* bead, Cobalt a deep *Blue*, Nickel *Reddish*, Copper

Pale Blue, Chromium *Green*, Manganese *Amethyst*.

(*e*) If the last test gives no reaction a little should be mixed with Sodium Carbonate and Potassium Cyanide and heated strongly in a hollow in a piece of charcoal in the reducing blowpipe flame. A metal bead results with Silver, Tin, Lead, Bismuth and Antimony, while an incrustation forms around the hollow—*Yellow* with Lead, *Bluish White* Antimony, *Brownish Yellow* Bismuth, *Reddish* Cadmium, *Yellow* while hot and *White* on cooling Zinc.

Lastly, some of the salt moistened with Cobalt Nitrate solution and again heated in the blowpipe flame may give a *Green* residue, Zinc, a *Blue*, Aluminium or *Pink*, Magnesium.

(*f*) This charcoal test may shew the Acid Radicle —Nitrates and Chlorates crackle, Hydrated Salts frizzle and dry up from loss of water, Sulphides, Sugar and also Benzoic, Tartaric and Citric Acids give a characteristic smell.

(3.) Wet Examination is nearly always necessary to determine the Acid Radicles.

(*a*) A few drops of strong Sulphuric Acid added to a little of the material to be tested and gently heated, may cause evolution of a gas which must be tested by cautious smell, moist litmus paper, lime water and flame. A gas is given off from Carbonates, Bicarbonates, Sulphites, Thiosulphates, Sulphides,

Oxalates, Fluorides Chlorides, Hypochlorites, Bromides, Iodides, Chlorates, Nitrites, Nitrates, Cyanides, Acetates, Tartrates and Citrates.

Charring shews the presence of an organic acid alone or in combination.

(*b*) Solubility must be tried in water, and if soluble, wet reactions can be used.

(*c*) If insoluble in water, Hydrochloric, Nitric or Nitro-Hydrochloric Acid should be tried and the excess of acid evaporated off, when the residue will probably be soluble in water owing to change of Acid Radicle. Here naturally only the Base can be tested for.

From the above brief directions it is evident that a great deal can be done with simple materials. For instance, *Chalk* or *Carbonate of Calcium* is often suspected to contain poison :—

Heated in a dry test-tube—no change ; heated strongly on a Platinum Wire—the flame is coloured dull Red shewing Calcium ; moistened with a little Sulphuric Acid —a gas is evolved which has no smell, but reddens moist, blue litmus paper ; it can be poured, being heavier than air, into a tube containing lime water which becomes milky on being shaken up with the supernatant gas, *i.e.*, it is Carbon Dioxide.

Taste is a most important test and can always be cautiously applied. For instance, the admixture of a little Strychnine to Chalk would be at once recognised by its exceeding bitterness.

CHAPTER IV.

Treatment of Poisoning.

(1) Removal of unabsorbed poison from the body.
(2) Counteraction of the physiological and pathological effects of the absorbed poison and neutralization of that which, though unabsorbed, cannot be removed.
(3) Symptomatic treatment and relief of adverse symptoms.

(1) Removal of Unabsorbed Poison.

From the Stomach this should be accomplished by syphonage and lavage with a large sized stomach tube and funnel. Unconsciousness does not interfere with this process. The holes at the blunt end of the tube are usually too small, but can be enlarged with scissors. The use of the tube is contra-indicated in cases of corrosive poisoning for fear of damage to the softened tissues.

The stomach pump is a relic of past ages, but can be used in the absence of a stomach tube. Lavage will usually be carried out with warm weak bicarbonate of soda solution ; exceptions will be mentioned under special poisons. This lavage is preferable to emesis in that it is certain, and with a wide-bored tube will entirely empty the stomach without causing the prostration of vomiting, which might be serious in a poisoned person.

Emesis must, however, be employed when no instrument is procurable. Emetics are *Zinc Sulphate* grs. 20, *Copper Sulphate* grs. 10, *Ammonium Carbonate* grs. 30, *Ipecac. Powder* grs. 30, and *Tincture or Vinum Ipecac.* ʒ 2. Any one of these well diluted with warm water and followed by copious draughts of warm water, will probably act efficiently.

Apomorphine gr. $\frac{1}{15}$ or $\frac{1}{10}$ hypodermically, is a certain and active agent and can be employed with an unconscious patient. It must, however, be used with caution since it causes great prostration, and its effects are often greatly prolonged.

Household emetics are common salt or mustard with warm water. Tickling the fauces with a feather may also be employed.

From the Intestine removal is obtained by purgatives and large simple enemata.

From the Vagina manual extraction with a speculum should be used and followed by a douche.

From the Skin and Subcutaneous Tissue poison may be removed by the application of a ligature above the wound, which is usually on a limb, followed by incision and sucking or wet cupping. After this the application of an oxidizing agent (potassium permanganate), caustic or cautery to the wound will aid in destroying any poison remaining. Cutaneous poisoning is usually the result of bites or stings.

2. Counteraction of the Effects by Antidotes.

Chemical Antidotes are substances which by a chemical reaction on the poison, render it inert. Examples

of such are carbonates of the alkalies and alkaline earths in acid, or weak acids (*e.g.*, Vinegar) in alkaline poisoning ; freshly precipitated hydrated oxide of iron in arsenic, potassium permanganate in opium, white of egg, in mercury poisoning ; and antivenine in snake poisoning.

Mechanical Antidotes by mechanical means render the poison harmless. Examples are : flour and water in cantharides poisoning, and demulcents, such as milk, gruels, white of egg and olive oil in irritant poisoning.

Physiological Antidotes should cause exactly opposite conditions to those due to the poison and so neutralize its evil effects, but none that are known do so completely. Examples are physostigmine in atropin, and atropin in opium poisoning. In some cases the antidotal effect is merely apparent as, with curare in strychnine poisoning which paralyses the motor nerve endings and so prevents convulsions without in any way affecting the central nervous system upon whose poisoned condition the convulsions depend.

Naturally caution must be used with such antidotes, as they are all themselves powerful poisons, and the condition of the patient may be rendered much more serious if poisoning by the antidote be added to the original state.

3. Relief of Adverse Symptoms.

Nature's attempts to get rid of poison must not be rashly checked, but treated rationally.

(*a*) The distressful *vomiting and purging* of irritant poisoning can be relieved by lavage of the

stomach and the administration of large simple enemata.

(*b*) *Pain* may be relieved by demulcents, hot applications and opium; but the last must be employed with caution lest it inhibit elimination of the poison.

(*c*) *Shock and Collapse* should be combated by warmth to the surface in the form of a hot bath or hot bottles. Hot drinks, such as tea, coffee or plain water, will be sometimes useful, but in irritant poisoning the inflamed painful condition of the stomach forbids their use as also that of medicines administered by the mouth, with the exception of demulcents. For this reason stimulants should be given hypodermically in the form of sulphuric ether m. 20 to the dose and strychnine as the liquor in m. 5, or sulphate gr. $\frac{1}{50}$. Alcohol should be avoided as causing a mere transitory stimulation with later greater prostration and lowered temperature. A sponge or cloth wrung out of very hot water which the hand can hardly bear, and placed over epigastrium and præcordium is a valuable aid.

A most effective and useful stimulant is an enema of two pints of very hot normal saline solution which should be repeated if necessary. If, however, the patient be pulseless, an intravenous injection must be substituted, since in this condition fluid will not be absorbed from the intestine.

Normal saline fluid for an enema or injection may be prepared by dissolving one and a half drachms of common salt (roughly a teaspoonful and-a-half) in one pint of boiling water and cooling to a temperature of 110°F. by placing the vessel in a larger one of cold water.

A temperature of 110°F. is just about as hot as the hand can bear.

To combat prostration and shock there is no agent so easily employed and so effective as a hot enema.

(*d*) *Remote Effects* of poisons, such as ulceration or contracting cicatrices after corrosive poisoning, and neuritis after arsenic will require appropriate treatment.

CHAPTER V.

Classification of Poisons and particular Toxicology of Corrosives and Irritants.

THE following is the usual classification, but some poisons belong to more than one group, while others, such as aconite, will not fall correctly into any of the classes :—

1. **Corrosives,** such as strong acids and alkalies, perchloride of mercury and carbolic acid.
2. **Irritants** (weak corrosives will fall under this heading)—
   (*a*) *Mineral*, such as arsenic, mercury in combination and many other metals, also phosphorus.
   (*b*) *Vegetable*, such as croton oil, gamboge, colocynth, capsicum and many reputed abortifacients.
   (*c*) *Animal*, such as cantharides and some ptomaines.
3. **Narcotics,** such as opium, belladonna, cannabis and chloral.
4. **Narcotico-Irritants**, such as dhatura.
5. **Convulsives,** such as strychnia and cerbera thevetia.

CORROSIVE POISONING.

The mineral and strong vegetable acids, carbolic acid, ammonia or the caustic alkalies are practically unknown as poisons in India.

Potassium Carbonate, $K_2CO_3 \times H_2O$. (Vernacular—*Jara khara*) is sold in an impure state in the bazars.

Sodium Carbonate $Na_2CO_3 \times 10H_2O$ is "washing soda" (Vernacular—*Sajji khara*). These two salts may be mixed and are then sold as "*Pappada khara.*" These in small doses or dilute solutions are generally harmless or act as irritants. Their corrosive power depends largely upon the amount of impurity as *caustic soda* and *caustic potash* which is always present in the crude salt.

Corrosive Sublimate $Hg\ Cl_2$ (Vernacular—*Darchikna*) will be described under mercury poisoning.

Fatal Dose—K_2CO_3 half an ounce, $Na_2\ CO_3$ six ounces have been recovered from, but half an ounce has caused dangerous symptoms.

Fatal Period.—This is usually prolonged and depends on the amount of corrosion and prostration. The potassium salt has caused death in four hours.

Signs and Symptoms.—Soreness with possibly excoriation of the mouth and fauces is at once caused with a soapy feeling in the former. Burning pain from throat to stomach follows. Vomiting is generally absent, but purging is common. Shock and collapse are always present.

Treatment.—Well diluted vegetable acids, such as citric, tartaric, acetic, vinegar or lime juice will neutralize the alkali, and this administration should be followed by a dose of castor oil, and demulcents such as white of egg, then be freely given.

Shock must be combated as already indicated, but hot drinks obviously must be avoided.

Remote effects due to ulcers or cicatrices may require treatment.

Post-mortem Appearances.—Signs of corrosion or excoriation may be present in mouth, fauces or œsophagus.

The stomach often contains stringy viscid material, sometimes dark in colour, from blood ; while the mucous membrane may be merely inflamed or show patches of softening and hæmorrhage, with possibly separation. Perforation does not occur.

Analysis and Detection.—The reaction of the mucous membrane of stomach and of the stomach contents should be taken with litmus paper. A strongly alkaline reaction suggests the presence of the drugs in question.

Hydrochloric acid added to the stomach contents may cause effervescence with evolution of carbon dioxide.

The success of these tests will depend largely on the time which has elapsed since poisoning occurred and upon the treatment adopted.

Detection of the Metal.—The organic matter must be destroyed (see page 17) and the residue rubbed up with distilled water and filtered, when potassium or sodium will be present in solution which should be evaporated to dryness ; or the mineral salts may be separated by dialysis.

Potassium.—1. Flame test (see page 28).

2. Platinum perchloride $PtCl_4$ with a strong solution gives a yellow precipitate.

3. Tartaric acid and alcohol give a white precipitate with a strong solution.

Sodium.—1. Flame test (see page 28).

Since sodium is universally present and all its compounds are soluble, the detection of a carbonate and absence of other metals is taken as proof that this salt is the sodium compound.

IRRITANT POISONING.

The following metallic irritants will be dealt with :— *Arsenic*, *Mercury*, *Copper*, *Lead ;* also the non-metallic *Phosphorus.*

The Vegetable Irritants will be described under Vegetable Poisoning.

ARSENIC.

This in the form of compounds is the commonest poison in India. It is easily procurable, being used for many purposes, namely, as a medicine, caustic, depilatory, dye, preservative for skins, and as a vermin killer. The restrictions on its sale are as a rule lax or inoperative.

Compounds met with in India.

White Arsenic, Arsenious Oxide or Arsenious Anhydride $As_2 O_3$ (Vernacular—*Phatkya somal or Somal-khar*).

This is sold in the bazars as vitreous white masses, or as a crystalline powder, prepared by subliming this. It is nearly insoluble in cold water, one-half grain in one ounce only, but twelve grains in one ounce of boiling water ; thus when mixed with cold food or drink a sediment is usually present while a white scum floats on

the surface. It volatilizes at 204° C. and will deposit on a cool surface as transparent, colorless octahedral crystals.

White arsenic is the commonest poison used and, owing to its white colour and tastelessness, can be mixed with foods, especially when finely powdered, without being readily detected.

The favourite vehicles are sugar, bread, milk, rice and halwā ; while for cattle it is mixed with gur or dough, and the mass wrapped in leaves or placed in the middle of an ear of maize. A method of cattle-poisoning in use in some districts is the thrusting of a sharp bamboo (Vernacular—*sui*) armed with arsenical paste through the animal's tongue.

As an abortefacient an armed stick is thrust into the vagina or even into the uterus.

Yellow Arsenic—Arsenious Sulphide or Orpiment $As_2 S_3$ (Vernacular—*Haritala or Baspati*).

This is not used nearly so often as the last compound. It is not so poisonous and is both harder to procure and easier to detect by the victim. It is used as a pigment and abortefacient and is sold in bright yellow vitreous masses, practically insoluble in water.

It is usually given in powder mixed with yellow sweetmeat where its colour aids in hiding it.

On heating strongly the sulphur burns away or sublimes and crystals of the oxide are deposited on a cool surface.

Red Arsenic—Arsenic Disulphide or Realgar $As_2 S_2$ (Vernacular—*Sandaracha or Munseel*).

This is rarely met with as a poison, although sometimes found as an adulterant in opium.

It is sold in red glassy masses and is almost insoluble in water.

Copper Arsenite and Copper Aceto-arsenite. —(Vernacular—*Hirwa*). These are both a bright green colour and are used as pigments to colour sweetmeats and toys as well as fabrics.

Poisoning by these is accidental.

Arsenic Poisoning.

This is usually homicidal, but also not infrequently accidental, and rarely suicidal.

Food and sweetmeats which have been doctored are often left lying about or casually thrown away and are picked up and eaten equally casually.

The following is an example :—A woman whose husband had upbraided her for infidelity prepared some sweetmeats and leaving them on a low shelf in the house went out. Two children finding the house empty, entered and finding the sweets ate some of them. One died and the other after severe vomiting and purging recovered. Particles of white arsenic were detected in the sweetmeat, the stomach of the dead child and the vomited matter of the other.

Other accidents are due to the carelessness of native shop-keepers who keep drugs and food-stuffs in close proximity to each other, also to the same failing on the part of hakims whose stock in trade is, not infrequently, kept tied in the corners of dirty rags with no apparent means of distinguishing one white powder from another.

White arsenic is the common agent in *cattle-poisoning* which is quite a trade, in some parts of the country, by the

chamar caste. These persons receive as a perquisite or for a low price the skins of dead cattle, which they can readily dispose of to leather merchants. The *chamars* use white arsenic to preserve the skins and so have the means of poisoning always at hand.

Arsenic poisoning may be acute, subacute or chronic, but only the former is at all common in India.

Fatal Dose.—*White arsenic*, two grains have proved fatal, but two ounces have been recovered from ; three grains is probably a dangerous dose. Immunity may be established by custom, although continued small doses are cumulative and shew their effects chiefly through the nervous system.

If the dose be in coarse fragments, vomiting may get rid of most of it, but a fine powder adheres to the gastric mucous membrane.

Fatal Period.—This is usually between fifteen and twenty hours, but death from shock has occurred in twenty minutes.

Signs and Symptoms of *Acute Poisoning* :— These are those of a typical irritant poison and commence as a rule within half an hour of ingestion. Opium and sleep may delay the appearance of symptoms.

Pain in the stomach, of a burning nature, with vomiting, is the first symptom, and is soon followed by colicky griping pain and purging. The vomiting and purging give no relief.

Dryness, with a feeling of constriction of tongue and throat are complained of, and thirst is present.

Cramps and twitching of the muscles occur later with, possibly, convulsions.

Collapse follows with a bluish pallor of the surface well marked in the fingers and nails.

There may be blood in vomit, stools and urine.

Dysuria is often present.

Death occurs from collapse and heart failure.

Opium will modify these symptoms and render the arsenic more deadly.

The resemblance to an attack of cholera is marked, and it is said that the presence of an epidemic is taken advantage of by poisoners.

Atypical cases have been observed where vomiting or purging are delayed or absent or where vomiting alone is present :

A man, of twenty-one years, ate some sweetmeat given him by a comrade with whom he had quarrelled regarding a woman. After half an hour, he complained of abdominal pain and later that his liver was being torn and twisted and his legs were cramped and twitching. He became collapsed and *seven hours* after ingestion of the sweets he vomited once and died, eight hours later, without further vomiting or any purging. Arsenic was detected in the viscera.

Treatment.—This should be carried out on the lines already indicated (see p. 34). Active lavage of the stomach should be employed with a weak warm bicarbonate of soda solution. It is true that this will aid in dissolving white arsenic, but it will also loosen the mucus in which the powder is embedded, sticking to the mucous membrane and so remove it.

Following this about two ounces of freshly precipitated ferric hydroxide should be left in the stomach, on

withdrawing the tube, in the hope that the remaining, unabsorbed poison may form the insoluble iron arsenite and so be rendered harmless. This antidote is prepared by adding *ammonia water* to *liquor ferri perchloridi* until no further precipitate falls. The moist red mass is then squeezed in fine muslin and washed in water to get rid of any free ammonia. It is then mixed with a little water and given by the tube, or in the absence of that, in teaspoonful doses, by the mouth, up to two or three ounces. It is quite innocuous, and a larger dose is more likely to pass on to the intestine and neutralize the poison there. Calcined magnesia is also an antidote, but no more efficient than the ferric hydroxide.

Relief of pain and combating shock will be necessary and large hot enemata are effective.

Demulcents can be given by the mouth.

Morphia should be withheld until the poison is removed from the alimentary canal, and then with due caution will be most useful to combat prostration and give rest.

It the patient be seen before a lethal dose has entered the blood, life can usually be saved, though rarely, remote after-effects may kill in months or even years. Peripheral neuritis may persist for a long time even after only one dose.

Post-mortem Appearances.—Stains on clothing or body from vomit or fæces are common. The body appears shrivelled with often brownish fluid oozing from mouth and nostrils.

The peritoneum over stomach and intestines is usually red and injected. The mucous membrane of the *stomach* is inflamed with patches of injection and hæmorrhage. Erosion, ulceration and gangrene are rare, and perforation

is unrecorded, probably because there is not time for these changes to occur. The appearance varies much, according to the amount of food in the stomach and the form in which the arsenic is taken :—

In one case in which deceased had fasted for five days before taking a dose of finely powdered white arsenic, there was an intense hæmorrhagic inflammation strictly localized at the cardiac end with no general affection of the mucous membrane ; in this case there was no purging.

In another case where a well diluted solution was drunk, there were no signs of stomach inflammation, but the intestines were markedly affected.

The lining of the stomach is often yellow in patches from the formation in it of $As_2 S_3$, or dark in streaks or patches from submucous hæmorrhage. Particles of white or yellow arsenic are often found adhering to the mucous membrane. Such particles, if discrete and removable, show the form in which the poison was taken but yellow spots which can only be removed by scraping are due to a deposit of the sulphide in the cells and result from either the white or yellow forms.

The small intestine usually shows inflammatory changes, but rarely are these seen in the *large gut*.

Subendocardial hæmorrhages are said to be common.

The alimentary canal is nearly empty ; a *colon* or *rectum* which contains *scybala* negatives arsenical poisoning, but to this rule there are rare exceptions.

Decomposition of the viscera is delayed, and maggots are absent from the contents of the *alimentary canal*.

Analysis and Detection.—The processes have been fully described (see p. 14).

Quantitative Analysis.—The classical process is long and complicated, but a rough idea of the amount can be obtained by taking a small measured portion and using *copper after copper* until no blackening occurs. The number used can be compared with the number obtained from gr. $\frac{1}{5}$ of white arsenic from a similar Reinsch's test.

Hankin's method is more accurate. All the *blackened coppers* are placed in a hard glass tube, just behind a mass of glass wool. Air is sucked through the tube so as to pass last through the wool plug and the coppers are strongly heated until all the *arsenic* is driven off. The coppers are then shaken out and the increase of weight of tube and glass wool is the weight of $As_2 O_3$. For this method the deposit on the copper must be thin, *i.e.*, the foil must not be left long in the Reinsch bath.

MERCURY.

This with some of its compounds are largely used in medicine and surgery. The sulphide is used as vermilion pigment and the perchloride largely as a disinfectant.

Compounds met with in India.

Metallic Mercury.—(Vernacular—*Para rosa*). This, though not a compound and not poisonous in mass, is sometimes used for suicidal or homicidal purpose.

In a finely divided state as in *Blue Pill*, *Blue Ointment*, or with *Chalk*, mercury *is* actively poisonous and readily absorbed.

Corrosive Sublimate.—Perchloride of Mercury $Hg Cl_2$ (Vernacular—*Talachikna sumbul*, *Darchikna*).

This is sold as white crystals which are only slightly soluble in water.

Strong doses act as a *corrosive* and weaker or when absorbed from the skin as an *irritant poison*. It is used for *homicidal purposes* and as a *cattle poison*, and is employed largely as a drug and disinfectant.

Calomel or Mercurous Chloride $Hg_2 Cl_2$ (Vernacular, *Ruskapur*).

This is sold as a white powder or in white masses and is insoluble in water.

As met with in the bazars it usually contains the *perchloride* as an impurity, sometimes to the amount of 10 per cent. and to this its poisonous properties are largely due.

Pure calomel is itself poisonous in large doses, but as a rule by acting as a purge it is got rid of in the excreta.

Mercuric Oxide or Red Precipitate HgO.—This is a red powder and occasionally used as a local abortifacient.

Cinnabar or Mercuric Sulphide HgS.—This is the vermilion of trade and is sold as a red powder or red mineral masses.

Mercury poisoning is usually accidental or due to attempted abortion. It is rarely met with in homicidal cases, but somewhat oftener as a cattle poison.

It is more commonly seen in the chronic form resulting from abuse of drugs.

Fatal Dose.—*Metallic mercury* in *blue pill* has proved fatal in a dose of six grains. *Corrosive sublimate*, three to five grains.

Fatal Period.—This is often prolonged to three or four days, but if corrosion be severe, death may occur rapidly from shock.

Signs and Symptoms: *Acute Poisoning.*—The symptoms are those of corrosive or irritant poisoning with a metallic taste. Vomiting, often of greyish matter mixed with blood, purging and suppression of urine are present.

Chronic Poisoning. This is not uncommon in the patients of hăkims, treated for rheumatism and syphilis or after the use of ointments or lotions.

There are usually present nausea, vomiting, dyspepsia, anorexea, diarrhœa, colic, salivation, softening of the gums with loosening and pain in teeth, necrosis of gums, teeth and jaws, skin eruptions, conjunctivitis, foul breath and coated tongue; congestion of kidney is usual and sometimes suppression of urine.

Peripheral neuritis is not rare, with muscular tremors.

In the later stagesin severe cases erythism, hallucinations and delirium may occur.

Recovery in the *acute* forms if it occur, is usually complete and so it is alsoin the *chronic* if there be no destruction of tissue.

Treatment.—*The acute form* must be treated as already indicated, but if there be much corrosion as judged by the condition of mouth and pharynx, the stomach tube can only be employed with great caution, or emetics may have to be relied on.

After lavage with warm water, *white of egg* should be introduced to form the insoluble albuminate and, washing again performed, after which a big dose of magnesium

carbonate should be left in the stomach and white of egg given by the mouth at intervals.

Treatment of shock and pain will be necessary.

It there be so much corrosion that passing a tube or emetics are held to be contra-indicated, *white of egg* and *magnesium carbonate* should be given freely by the mouth.

A large enema to wash out colon and rectum should never be omitted, and the bladder should be emptied by catheter.

In chronic poisoning the drug must be stopped, and the bowels kept active, while conditions of mouth, gums, etc., are treated appropriately.

Post-mortem Appearances.—If the solid or a strong solution is the agent the mucous membrane of mouth, pharynx, œsophagus and stomach will be a greyish colour, while weaker solutions will cause a vivid red with hæmorrhagic patches. Ulceration of the stomach is rare.

The mucous membrane of the small and sometimes also of the large, intestine is red and inflamed.

In *chronic poisoning* the mucous membrane of the alimentary canal may be blackened from a deposit in it of the black sulphide.

The kidneys are granular with sometimes a calcareous deposit in the cortex.

The gums and teeth may show signs of ulceration and loosening, etc.

Analysis and Detection.—Mercury is not infrequently found in the solid viscera, large intestine and urine, when absent from the stomach and its contents.

Reinsch's test already fully described will show the presence of mercury, though not the nature of its combination.

Corrosive Sublimate is readily detected :—

The solid sublimes and deposits as a haze, on the cooler part of a test tube, seen microscopically to consist of prismatic crystals arranged in stars, crosses or singly. A solution with *potassium iodide* gives a red precipitate soluble in excess to a clear fluid, with *sulphuretted hydrogen* gives a precipitate first yellow, then brown and finally black, with *silver nitrate* gives a white precipitate soluble in ammonia, thus shewing the presence of chlorine.

COPPER.

Poisoning by the compounds of copper is rare and usually accidental and non-fatal. Occasionally it is due to the use of dirty copper or brass cooking vessels, on which a thick layer of grease has been left. Homicidal use of copper is very rare.

Copper salts are sometimes added to tinned vegetables to give a bright green colour, but the quantity is probably insufficient to do harm.

Compounds which have caused poisoning in India.—**Copper Sulphate** Blue Vitriol, Blue Stone or Copperas $Cu\ So_4 \cdot 5H_2O$ (Vernacular, *Moratul* or *Nilatulia*).

This has been used for suicide and homicide, but for the latter purpose its taste renders it unsuitable.

Copper Acetate—or Verdigris CuO. CH_3. CO_2H (Vernacular, *Zangal or Pitra*). This when pure is in the form of green transparent crystals.

Fatty Acid Salts.—The most important is the *oleate* which is formed by the action of greasy food on brass or copper vessels and so is the cause sometimes of accidental poisoning.

Vegetable acids also act on Copper.

Fatal Dose.—*Copper sulphate* in a dose of one ounce has proved fatal.

Copper acetate, half an ounce. Probably much smaller doses would prove dangerous.

Fatal Period.—This has varied greatly, in one case on record it was only four hours.

Signs and Symptoms.—*Acute Poisoning.* The usual signs of an irritant with probably blue or green coloured vomit will be present. The addition of ammonia will distinguish this colour from that due to bile, by giving a deep blue precipitate of the copper hydroxide, soluble in excess of the reagent.

Chronic Poisoning : Copper is an accumulative poison. The symptoms are nausea, vomiting, a metallic taste, colic and diarrhœa. A blue line is sometimes seen on the gums due to a deposit of the sulphide in the mucous membrane. Peripheral neuritis and wrist-drop are sometimes present and, if persistent, will delay complete recovery.

Treatment.—Acute poisoning demands stomach lavage with administration of white of egg followed by

a brisk purge and the usual symptomatic treatment of irritant poisoning.

The Chronic form demands stopping the supply of the poison and symptomatic treatment.

Post-mortem Appearances.—These are those of an irritant poison with green staining of the mucous membrane of the stomach and intestines.

Analysis.—(see page 16).

Chemical Tests :—(1) Sulphuretted hydrogen gives a black precipitate insoluble in hydrochloric acid.

(2) Ammonia gives a deep blue precipitate soluble in excess.

(3) A bright piece of iron such as a clean French nail placed in a faintly acid solution of a copper salt becomes coated with metallic copper. This is a very delicate test and occurs in the presence of organic matter.

LEAD.

Lead poisoning is occasionally seen in India and may be said to be always accidental. In Europeans, cases sometimes occur as the result of tinning of copper cooking vessels with *kalai* adulterated with Lead.

Red Lead or Minium $Pb_3 O_4$ (Vernacular, *Sindura*) is sometimes mixed with other ingredients as a *cattle poison*, or for arming *abortion sticks*. Its red colour has apparently caused it to have properties ascribed to it which it does not possess. As an example of superstition regarding it the following case is of interest : An

English officer was after dinner in mess attacked with purging and vomiting from which he recovered next day. In the morning he found between the pillow slip and pillow two cloves smeared with *red lead* paste. The explanation was, that one of the servants, having incurred his master's anger, consulted a fákir and received a white powder and the red cloves as a charm, by which to recover favour. The powder which probably contained arsenic was apparently mixed with the after-dinner cup of coffee and the cloves placed in the pillow.

Lead Acetate is used in medical and surgical practice, but, in India, poisoning by it is practically unknown.

Fatal Dose.—This is not known, but recovery has followed the swallowing of one ounce of the acetate. Lead is a cumulative poison, and chronic symptoms follow the continued taking of minute doses.

Signs and Symptoms: *Acute Poisoning.*—The usual signs of irritant poisoning are present but *without purging*. Colic and constipation with retracted abdomen are present. Tenesmus is sometimes troublesome.

Chronic Poisoning.—The symptoms are varied and numerous. Colic and constipation set in early with anæmia and anorexia. There may be a blue line on the gums, but not with persons who keep their teeth clean. Peripheral neuritis is very characteristic, and usually first affects the musculo-spiral nerve causing *wrist-drop*. The supinator longus muscle usually escapes the paralysis affecting the extensors and supinators, because it is largely supplied by the musculo-cutaneous nerve, since it is a flexor of the elbow.

Paralysis of the foot extensors often occurs also, and then the tibialis anticus, which is homologous to the supinator longus, escapes, although the peroneal nerve is affected. Sensory phenomena are usually absent as are trophic changes.

Bright's disease due to granular kidney with albumenuric retinitis is common.

Gout and joint affections are not unusual.

Obscure nervous symptoms are present in severe cases.

Recovery is delayed by the nerve changes and kidney disease.

Treatment.—This in the case of the acute form is that of irritant poisoning, but morphia is necessary to arrest the intestinal spasms and allow passage of the contents.

The Intestines must be cleared out by purges of magnesium and sodium sulphate, which also precipitate the lead as insoluble sulphate. Large enemata of magnesium sulphate (ʒ iv to Oi) should be given. In chronic cases the cause must be found and the supply stopped. Sweating, purging and diuresis must be induced. If there is much colic, opium or hyoscyamus will be necessary. Massage and electricity will benefit the neuritis.

Potassium iodide is given with the idea of precipitating the iodide in the tissues ; it is of doubtful utility.

Post-mortem Appearances.—In acute poisoning there will be signs of irritation with probably a dark deposit of lead sulphide in the mucous membrane of stomach and intestines.

In the chronic form there may be a blue line on the gums, wasted muscles of the extremities, granular kidney, retinitis and optic atrophy and signs of gouty arthritis.

Analysis and Detection.—(*See* p. 16). The examination of urine and fæces is important.

Chemical Tests :—(1) Sulphuretted hydrogen gives a metallic-looking black precipitate insoluble in hydrochloric acid, but slightly soluble in pure nitric acid. If the solution of lead is very weak, a dark coloration only is produced.

(2) Potassium iodide gives a bright yellow precipitate soluble in boiling water, and crystallizing out on cooling as glittering yellow scales.

(3) Potassium chromate gives a light yellow precipitate.

(4) A metallic Bead is easily obtained from a dry salt by the blowpipe (*See* p. 28).

PHOSPHORUS.

This agent is rarely used homicidally or suicidally in India nor is accidental poisoning common, probably because phosphorus vermicides are seldom employed.

When seen it is almost always a result of the heads of matches having been mixed with food.

Fatal Dose.—One-ninth of a grain has caused death, but probably one grain is an average lethal dose.

Fatal Period.—This varies from half an hour to a few days or even weeks.

Signs and Symptoms. — Chronic poisoning is unknown in India. In *acute poisoning* the usual signs of an irritant are present. The breath has a characteristic garlic-like smell. Vomiting may occur at once or be postponed for hours, depending on the amount and nature of the food present in the stomach. The vomit is often phosphorescent and contains nearly pure blood. Thirst with burning pain of throat and stomach, is intense. Purging with occasionally luminous stools, follows. Shock and collapse are intense.

Treatment.—This must be that usual in irritant poisoning with the use of potassium permanganate solution gr. $\frac{1}{2}$ to Oi of water or $\frac{1}{10}$ per cent. Copper sulphate is recommended and is said to coat the particles of phosphorus with metallic copper and render them inert, gs. x well diluted may be given as a dose and repeated. A demulcent in the form of white of egg should be employed. Oils and milk are to be avoided for phosphorus is soluble in fats and oils.

Oxidizing agents are recommended such as *sanitas* (which contains H_2 O_2), or old or *French turpentine* (which contains *ozone*).

Morphia will probably be required to relieve pain and combat shock.

Post-mortem Appearances.—Ecchymoses under skin and mucous membrane are common.

A smell of garlic may be noticed on opening the abdomen and viscera, but in India this will usually be obscured by putrefactive changes. A luminosity of the contents of the viscera may be observed in the dark.

Particles of the red or yellow tips of matches may be found. The gastric mucous membrane is puffy and yellowish white in colour.

Analysis and Detection.—Any particles must be removed and tested.

Chemical Tests.—The presence of sulphuretted hydrogen or turpentine interferes with these ; therefore, it is necessary to know if the latter was given as treatment.

Mitscherlich's Test :—The organic matter, after fine division with scissors, or bits of suspected matter are placed in a flask, connected with a cooled condenser and receiver, both of glass. Dilute sulphuric acid is added to the contents of the flask and distillation carried out over a water bath, in a dark chamber. The presence of phosphorus is shewn by a flickering luminosity in the flask and condenser, and silver nitrate, through which the resulting gas is bubbled, becomes blackened, from reduction of silver. If pieces of sulphur be added to the flask contents they become luminous (Lipowitz).

CHAPTER VI.

Vegetable Poisons.

The effects of these are very various, and a botanical classification is probably preferable to a toxicological. As with mineral poisons only those which are used in India will be dealt with.

OPIUM.

This agent is after arsenic responsible for the largest number of deaths from poisoning. Whereas arsenic is the favourite with the homicide and cattle poisoner, opium is selected by the suicide and infanticide. Women who have been scolded or beaten by their husbands, and youths whose parents have annoyed them, frequently resort to its use, often no doubt merely with the idea of terrifying their relatives. Female children and the offspring of enemies are often victims to opium. It might be supposed that this drug would be often used as a narcotic to facilitate crime, but it seems that *dhatura* is preferred for this purpose ; however, opium is often detected in sweets and bread in a smaller quantity than would cause death ; in such cases it is likely that the narcotic effect only is desired. Opium is in constant use by the people as sedative and stimulant, and will enable excessive fatigue and privation to be sustained. It is also employed to enable continued sexual indulgence to be enjoyed. Accidental

deaths are not rare, as might be expected from the general use of this drug. An instance of such an accident is the following:—A man who had quarrelled with his mistress, was in consequence depressed, and so starved for three days, he then made up the difference and visited his lady-love, who gave him a drink of liquor. He noticed a bitter taste and soon afterwards vomited. He then became drowsy and died in fifteen hours. The presence of opium in quantity was found in the viscera. It is probable that only the aphrodisiac effects were desired, but either from a mistaken dose or because of the weak condition of the man, with empty stomach and intestines, an ordinary amount proved fatal. Opium when taken in moderate doses up to five grains daily, appears to have little or no evil effects, but in larger quantities and with continued indulgence it causes grave results, though these are rarely seen in India. The picture of an opium-eater or morphinomaniac has been so often drawn that a repetition is unnecessary.

Habit allows large quantities to be consumed with impunity. As a cattle poison, opium seems not to be used, but in one case a quantity of it was found in a piece of bread said to have been removed from a bullock's mouth, the animal subsequently dying ; in this case the police suspected nux vomica which, however, was not detected.

Opium.—(Vernacular, *aphiyun or aphim*) is the dried inspissated juice of the *Papaver somniferum* or *opium poppy*. In various forms it is largely used in medicine. A specimen of good opium as found in the bazar is a, nearly black, sticky mass of firm uniform consistence and granular texture, but mouldable by firm pressure.

It is slightly ductile and breaks with an irregular brown fracture. The smell is "heavy," but not unpleasant. The taste is bitter and mawkish.

Adulterants, such as gums, catechu, vegetable juices, sugar, farinaceous matter, seeds, petals, leaves and earthy matter, are not uncommon. Some specimens are found quite hard and brittle, having been overheated in preparation or drying. Opium contains a number of active principles or alkaloids united with *meconic acid ;* of these the chief are *morphine*, *narcotine*, *codeine* and a convulsant *thebaine*.

Morphine in a good specimen is of 5 to 15 per cent., while *narcotine* is of 3 to 8 per cent. The drug as might be expected from its constitution, has in addition to powerful narcotic effects, others which differ in different individuals and animals. On some adults and most children opium acts as an emetic, while on others it has a convulsive effect, as it has on cats, dogs and frogs. Birds are immune and goats nearly so.

Children are extremely susceptible.

The following is an instance of the atypical effects of a medicinal dose : A medical man gave a patient, an adult, an ordinary dose of opium and chalk. In half an hour faintness came on with pain and stiffness of the muscles at the back of the neck and shoulders ; these symptoms remained for some hours, but no true narcosis followed. The doctor took himself, as a test, the same dose, and was seized with vomiting which recurred once or twice ; drowsiness was present. An analysis of the drug shewed only a quantity of opium double that authorized in the British Pharmacopœia ; no *apomorphine* nor *strychnine* was present.

On some persons the drug has, instead of a narcotic, a kind of intoxicating stimulant effect.

Morphine.—This alkaloid is a white crystaline body, existing in opium as the meconate. As a drug, salts, such as hydrochlorate, acetate and sulphate, are used. On man it acts purely as a narcotic. The alkaloid itself is nearly insoluble in water, but is freely soluble in alcohol, less so in amyl alcohol and acetic ether. It is freely dissolved by dilute acids forming salts which are all soluble in water and alcohol.*

Fatal Dose.—Opium : four grains have proved fatal to an adult and one-fifth of a grain to young children. Morphine : one grain is a dangerous dose for an adult.

Two minims of tincture of opium, or if the drug was of B. P. strength $\frac{1}{90}$ grain of opium killed a young infant. In another case one grain of Dover's powder or $\frac{1}{10}$ grain of opium proved nearly fatal to a baby.

Fatal Period.—The average period is five to ten hours, and it is said that if the patient survive twenty-four hours, recovery will follow. The shortest recorded period is forty-five minutes.

Signs and Symptoms.—There is usually a brief period of exaltation, with flushed face and hot skin. This is followed by drowsiness with vertigo, and a desire to be left alone to sleep. Unconsciousness, with relaxed muscles, soft slow pulse and noisy slow respiration with cyanosis follows, but the patient can still be roused incompletely by energetic measures. The pupils are minutely contracted, and insensitive to light. Respiration

* This is characteristic of all the alkaloids.

soon becomes slower and shallower, while the blue colour of the face deepens. The heart beats weakly and irregularly, while coma becomes absolute and the pupils dilate. Soon respiration only occurs at intervals, which become longer toward the end, and the heart's beat cannot be felt. Urine is usually suppressed from the commencement.

With large doses and rapid absorption narcosis and coma may occur at once, with dilated pupils and speedy death. This form of poisoning is common with an overdose of morphia hypodermically administered. Atypical symptoms are gastric irritation and vomiting or tetanic convulsions.

Occasionally it happens that the patient, after rousing in the early stages, appears to be recovering, and then the symptoms recur, and death follows. The explanation of this is that during the stage of great depression absorption of the poison probably ceases, but when stimulation has improved the circulation, another dose is taken up from the alimentary canal.

A constant and characteristic sign is the smell of opium at the mouth. This is unmistakable unless masked by the smell of spirits which may have been given by injudicious friends.

In *children* convulsions are not uncommon.

Birds and goats are nearly immune to this poison, while on cats and dogs it acts as an excitant and intoxicant. Frogs with large doses of opium or morphine are affected with tonic convulsions of short duration, but no true tetanic condition ; small doses, such as one grain of opium or $\frac{1}{4}$ grain of morphine, have no effect.

Treatment.—This, if undertaken early is usually effective, but if a lethal dose has been absorbed into the circulation, it will probably prove useless for the reasons indicated on page 13.

Energetic lavage of the stomach, with the tube and permanganate of potash solution (15 grs. to the pint) must be carried out. After this, half a pint of the solution with one ounce of castor oil should be left in the stomach, in the hope of its passing on into the small intestine. A hot enema, of normal saline solution, should always be given, for this will be absorbed and flush the tissues leading to sweating and probably polyurea. Thus, absorbed poison which has not chemically united with the tissue protoplasm may be eliminated.

Hot applications to the præcordium should not be omitted.

If the heart show signs of weakening, sulphuric ether in 20 minim doses, should be injected hypodermically, and repeated after an hour, if necessary. If respiration slow to less than eight per minute or be shallow, artificial aid at the rate of sixteen to the minute must be afforded. The interrupted Faradaic current applied with one terminal over the costal angle, and the other behind the sterno-mastoid at the level of the fourth cervical vertebra, may be of use to stimulate the diaphragm through the phrenic nerve, but properly applied artificial respiration is certain and easy of performance.

Atropin sulphate in doses of $\frac{1}{30}$ grain hypodermically repeated until the pupils begin to dilate, has been strongly recommended. It is only of use to counteract the effect of morphine on the heart and should not be used unless the beat be feeble or irregular.

Flicking the face and chest with the corner of a wet towel will reflexly stimulate respiration and circulation.

Alcohol must be absolutely avoided. Apart from other reasons it will dissolve any unabsorbed opium in the stomach and facilitate its entry into the circulation. Hot coffee in the absence of other stimulants may be given, after emptying the stomach.

Obviously, evacuation of the stomach, preferably by lavage and the tube, but in the absence of apparatus by active emesis, must precede all other treatment.

Walking the patient about, in mild cases, if he uses his own muscles will be useful, but if respiration and circulation do not benefit thereby, it must be abandoned as it can then only be harmful. Permanganate of potash decomposes morphine and the other alkaloids, and this reaction will take place in the stomach as was shewn in the following case : A woman with all the signs of opium poisoning, was treated with lavage of the stomach, first with hot water and then with permanganate of potash solution. In the first washings morphia and meconic acid were detected, but the latter only, in the second. In the remaining contents of the stomach removed after death meconic acid in marked amount, but only a mere trace of morphia were found. The blood and juices obtained from the solid viscera yielded a trace of morphia but no meconic acid. That is, the treatment had destroyed unabsorbed morphia, but could naturally have no effect on that in the blood or tissues. This drug is an antidote to opium in the alimentary canal, but since it is not absorbed as permanganate it can serve no good purpose if injected hypodermically.

Post-mortem Appearances.—Congestion of the brain, lungs and liver is present, but is merely a sign of death from Asphyxia. Traces of solid opium may be found in the stomach (see page 8), but the smell will usually, in India, be obscured by putrefaction.

Analysis and Detection.—In examining any material suspected to contain *opium* a search should first be made for particles of the drug, for if these be found much time and trouble will be saved. It is rare for opium to be found, as such, in a putrid stomach, but in food material, such as bread, the brown substance can often be picked out with a knife, while in gruel, dâl and rice, chillies, etc., sticky fragments can usually be seen and removed.

The process for extraction of meconic acid and morphine from organic matter and their tests have been fully dealt with (see pp. 21 & *seq.*). It may be remarked that although other bodies give very similar reactions with ferric chloride to those of meconic acid, yet if the extraction process has been properly carried out, a body reddening with the perchloride and not bleached with a few drops of dilute hydrochloric acid can only be meconic acid, and meconic acid only occurs naturally in opium.

Proof of the presence of morphine is only afforded by obtaining a crystallizable body giving the reactions of that alkaloid.

DHATURA.

Daturine is the active principle or alkaloid contained in the various parts of *dhatura* plants which belong to

the natural order Solanaceæ. The commonest variety in India is the *dhatura stramonium* (Vernacular, *Săfēd* or *Kālā dhatura* or *Umattai*). It occurs as a shrub from two feet to fifteen feet high. The leaves are smooth and ovate and some three and-a-half inches long, the flowers white or purple, are bell-shaped. The fruit or thorn apple is globular and covered with short spines ; it contains in compartments numerous brownish yellow seeds about one-fifth of an inch long and much the same size and shape as *capsicum* seeds. These seeds are used by native practitioners in the treatment of fevers. The leaves are employed as an anodyne application. An infusion of seeds or leaves is used sometimes to fortify country liquors, and the crushed seeds as an ingredient of sweetmeats in *majoon*. In Europe the dried leaves are used as *asthma cigarettes*. Dhatura, usually as the seeds, is very commonly used as a narcotic poison to facilitate the commission of crime, but since the amount employed is not gauged, death not infrequently occurs when probably not desired. The whole or crushed seeds are usually mixed with food or drink, and of necessity the gravity of result depends upon the amount which the victim takes and retains.

The following is an example of *dhatura* poisoning : A party of eight pilgrims halted for the night on the outskirts of a village into which one man went to purchase the evening meal. After cooking and eating the food all the party were seized with vomiting and other signs of dhatura poisoning. Four died and four recovered, among the latter being the purchaser of the food. This man took very little to eat and probably exaggerated or simulated

his symptoms. It appeared, at the investigation, that this man did not come from the village of the other seven, but had joined them on the road, and had seized the opportunity to drug the food which he procured in the village, with doubtless the intention of stealing the valuables of the entire party. Fragments of the seeds were found in the stomach contents of the deceased victims and in portions of food remaining in the cooking vessels. No sign of dhatura was detected in any of the samples secured from the shop of the vendor in the bazar, who was accused by the poisoner of supplying him with doctored food.

Another instance which was unexplainable was as follows: Four *saiyads* returning home from a pilgrimage, in the Mohárrám, drank *shărbăt* together. They were all seized with symptoms of poisoning and died. Fragments of dhatura seeds were found in the stomach contents of all. That one of the four was the poisoner is very doubtful, for all died. It is also unlikely that any outsider would wish harm to the holy men who drank in the name of the Prophet. It appeared to be an instance of carelessness so typical of the illiterate in their handling of dangerous drugs, and dhatura is popularly supposed to be a non-dangerous agent.

Fatal Dose.—This is not accurately known, but a decoction of 125 seeds has caused death.

Fatal Period.—This may be very short; in one case death occurred seven hours after ingestion, but twelve or fifteen hours is more common. As a rule recovery, after a varying period of unconsciousness, follows.

Signs and Symptoms.—Vomiting usually follows ingestion, because the seeds, especially when crushed, act as

a gastric irritant. Dryness of the throat with thirst and difficulty in swallowing and sometimes pain in the stomach are soon complained of. Dizziness and difficulty in walking, from incoördination of the voluntary muscles, follows, and later hallucinations and stupor. The pupils are widely dilated and insensitive to light. Diplopia and paralysis of accommodation are present. The conjunctivæ are red and injected. Before narcosis is absolute there is busy, muttering delirium with confused speech and picking movements of the hands and fingers. This last sign is very characteristic.

The involuntary muscles are paralyzed and retention of urine is common. A stool may be passed from relaxation of the sphincter ani but there is no purging.

Death when it occurs results from failure of the heart and respiration, but recovery after weakness and headache usually takes place.

Treatment.—Evacuation and lavage of the stomach should be carried out, while a large hot enema will act as a stimulant, and by flushing the body, aid in elimination of absorbed poison. Pilocarpin nitrate is recommended as an antidote and should be given hypodermically.

Post-mortem Appearances.—Pathologically there is nothing characteristic. Seeds, fragments of seeds or leaves may be found in stomach or duodenum.

Analysis and Detection.—Detection is attained by finding seeds, or by detecting fragments resembling pieces of the seeds and confirming this opinion by extracting a mydriatic principle. If no such material can be found and yet a mydriatic principle is obtained, it is

strong presumptive evidence of the presence of dhatura in some form, since practically the other mydriatic drugs are not used as poisons.

There is no reliable chemical test. The physical features of dhatura seeds are very characteristic, and although capsicum seeds are somewhat similar, if whole seeds are procurable no mistake is possible, while the practised eye can distinguish even minute fragments of the testa, while the physiological difference is absolute. Both seeds are reniform in shape, but flattened, and one-fifth of an inch long. In dhatura the convex border is double ridged, and in capsicum single and sharper. A sagital section, to cut the seed into flat halves, shows the dhatura embryo curving outward at the hilum (or notch of the kidney), but inward like the figure 6 in capsicum. In both the testa is pitted, and under the microscope is seen to consist of convoluted ridges, around the depressions, reminding one of cerebral convolutions ; those in dhatura may be seen over the whole surface, but in capsicum only near the border, the middle portion being smooth. The convolutions in dhatura are very regularly arranged and have a general circular or oval form, while in capsicum they are quite irregular and wander hither and thither without a definite pattern. The testa is of a brown or black colour in dhatura, and of a pale yellow in capsicum. The mydriatic active principle may be rapidly extracted by digesting the material for about half an hour in warm rectified spirit, filtering and evaporating on an open water bath to dryness. This residue can now be rubbed up with about half a drachm of distilled water just acidulated with dilute sulphuric Acid. A few drops

of this can be placed in the eye of a cat, dog or kid, but herbivora do not react so well as carnivora.

After about one hour the animal should be held up to a strong light and the pupils compared. This mydriatic principle appears to be destroyed by putrefactive changes in the body, but can be obtained after some lapse of time, in vomit or from earth upon which the subject has vomited.

ACONITE.

The active principle of the aconite plants is an alkaloid *aconitine*, which itself is decomposable into another alkaloid aconine and acetic and benzoic acids.

Aconitum Ferox (Vernacular, *Bish* or *Bikh*) is a plant two to five feet high. The poison is chiefly in the root, which is a conical, fusiform tuber, two to five inches long. The leaves and stems are also poisonous, but contain but little of the alkaloid compared to the root. The root when fresh has a smooth surface, but when sold in the bazar it is quite dry and usually crinkled and dark in colour. This change is due to soaking in cow's urine and drying.

Aconitum Napellus is another poisonous variety very similar to aconitum ferox.

Aconitum Heterophyllum (Vernacular, *Atis*) is said to be non-poisonous.

Aconitum Palmatum (Vernacular, *Bikhma*) is also non-poisonous.

Aconite, as the powdered root, or a decoction of this in water, is used as an anodyne application and given

internally as a remedy in certain fevers. The tincture which is officinal in the British Pharmacopœa used to be largely given in a sthenic fevers, but very few practitioners now prescribe it.

Poisoning with aconite is often accidental, but it is used homicidally and also as a cattle poison.

Aconitine is one of the most powerful poisons known, but as such is not used in India ; the powdered root is employed for homicidal purposes, and legitimately by native practitioners as a drug ; it is also sometimes added to native liquors to increase the intoxicating power.

Aconite poisoning is not common, and when it does occur is often difficult to detect *post-mortem*, especially when putrefaction has occurred.

Fatal Dose.—Severe symptoms have followed the taking of fifteen grains of the root, and thirty grains would probably prove fatal.

Aconitine in $\frac{1}{20}$ grain would probably be dangerous.

Fatal Period.—This is usually from three to six hours, but death has occurred in twenty minutes.

Signs and Symptoms.—Tingling of the lips, tongue, mouth, and fauces occurs immediately, and is soon followed by numbness and anæsthesia of these parts. A burning sensation in the stomach with tingling of the skin, especially of the face, soon follows. Vomiting usually occurs, but purging is rare.

Later, numbness and anæsthesia replace the tingling of the skin, the patient often rubbing hands and arms to relieve it.

Shock with small feeble pulse, and rapid, shallow, laboured respiration rapidly ensues.

The face is pallid with anxious expression, while the pupils are moderately dilated and insensitive to light.

Paralysis of the voluntary muscles occurs and is complete in fatal cases. This and the anæsthesia are due to affection of the nerve terminations.

Death takes place from failure of heart and respiration, the vagus being paralyzed at its terminations.

Consciousness is not lost till near the end.

Treatment.—The stomach must be emptied and washed to remove any unabsorbed poison. Shock and collapse should be treated as indicated on p. 34.

Hypodermic injections of atropin are recommended and may be repeated from time to time.

Digitalis has been proposed to counteract the depression of the heart's action, but since the vagus terminations are paralyzed and this drug acts through the vagus, it is contrary to our knowledge of therapeutics and an irrational treatment. Stimulation of the *heart muscle* through the blood should be useful.

Post-mortem Appearances.—General venous congestion due to heart failure is marked. The gastric mucous membrane is congested and often inflamed. Fragments of the root may be found in the stomach contents.

Analysis and Detection.—The suspected material such as food, vomited matter or contents of the stomach must be carefully searched for fragments of the root. If found these can be washed with distilled water and chewed between the front teeth. The residue should be spat out and the mouth rinsed with distilled water. The very smallest fragment thus treated will cause a

tingling of the tongue and lips followed by a cold numbness lasting for several hours. The fragments may be macerated in absolute alcohol for two or three hours and the mixture filtered. This filtrate is then to be evaporated to dryness on a water bath kept below boiling point, and the residue dissolved in a little distilled water just acid with acetic. A few drops of this should be tested with the tongue tip and the rest injected into a *frog* (see p. 19).

If no fragments can be found the material must be extracted as for other alkaloids (see p. 25), using *tartaric acid* to acidify, and keeping the temperature of all evaporations below boiling point. The residue from the ethereal chloroform should be treated as indicated above for the alcoholic residue. If there be no taste reaction then there will be no physiological effect on the frog, for the former will be given by $\frac{1}{1000}$ grain aconitine. There is no reliable chemical test for aconitine. Analysis very frequently fails to reveal the presence of *aconitine* in viscera and their contents, but in vomited matter it is usually detectable. The alkaloid is apparently altered by putrefactive changes. It is, therefore, of the highest importance that all available material should be submitted to examination. In India, however, it is difficult to obtain vomit as such. The patient usually is sick on to the ground which is dug up and forwarded to the analyst. It is not unusual for some ten or twelve pounds of dust and earth to be sent, which may or may not contain the results of vomiting. In any case it is improbable that the most careful extraction will obtain the alkaloid in recognizable quality and quantity from this source.

STRYCHNINE.

Strychnine is the poisonous alkaloid of various varieties of the *strychnos* species.

Strychnos Nux Vomica.—(Vernacular, *Kuchila*) is officinal in all pharmacopœias. All parts of the plant are poisonous, with an exceedingly bitter taste, but the seeds most so.

Nux vomica seeds are shallow saucer-shaped discs ¾ inch in diameter and with a grey silky testa. The hilum is in the centre of the concave surface. The two alkaloids, *strychnine* and *brucine*, are present in combination with *igasuric acid* and are both highly poisonous.

Preparations of these seeds are used in medicine, as vermicides and for poisoning dogs and cattle.

The plant bark or *false Angostura bark* is also poisonous, and is used as a tonic. Its substitution for harmless bitters and astringents has caused death.

Strychnos Ignatii bears the poisonous beans of St. Ignatius which are ovoid, one inch long, and bear several flat surfaces.

Homicide in India by strychnine or nux vomica is rare, but said to be increasing. Cattle and dog poisoning by this agent is not uncommon, and for this purpose the roughly pounded seeds are mixed with food-stuffs.

Strychnine.—This alkaloid is exceedingly poisonous, and since it gives rise to tetanic symptoms may cause appearances mistakable for tetanus.

Fatal Dose.—The alkaloid in ½-grain dose has caused death, while probably thirty grains of powdered seeds would be dangerous or fatal.

Fatal Period.—Death may occur in less than half an hour, but usually a period of five or six hours elapses. Hypodermically a poisonous dose of the alkaloid would act very rapidly.

Signs and Symptoms.—Strychnine probably acts by uniting with the protoplasmic molecules of the *central nervous motor system*, and therefore the signs are chiefly convulsive and, as mentioned, resemble nearly those of tetanus. After ingestion the bitter taste and burning sensation in the stomach are followed by a feeling of tightness in the chest. Twitching and cramps of the voluntary muscles soon appear, and are first noticed in the loins and legs (those due to tetanus are first noticed in jaws and neck). Soon very painful tonic spasms set in affecting all the muscles of trunk and limbs. The face and neck are the last affected (cp. tetanus). A spasm is followed by complete relaxation which may be of from five to twenty minutes' duration (in tetanus such relaxation does not occur). External stimulation even in the mild form of a draught of cold air precipitates a convulsion. During the spasm partial suffocation occurs from fixation of respiratory muscles. Toward the end the intervals of rest become shorter and death results from asphyxia and exhaustion. Consciousness is not lost till near death. The temperature is little if at all raised (in tetanus the temperature is always raised, sometimes to hyperpyrexia).

Treatment.—Evacuation and lavage of the stomach are necessary, and often can only be performed with the help of *chloroform*. After this a solution of *tannin* or *strong tea* should be left behind on withdrawing the tube.

Chloroform must be given in serious cases, and since during a spasm respiration ceases, skill is needed to push the administration just before one is expected so as to obtain its effect when needed, and yet give as little as possible during the intervals of rest. The anæsthetic may be required for many hours and during its administration nourishment in the form of nutrient enemata should be given at intervals. In the absence of chloroform chloral may be given by the mouth or rectum.

If there be spasm of the glottis, tracheotomy must be performed. Artificial respiration in animals is said to have allowed large doses to be recovered from them, but since the respiratory muscles are fixed during a convulsion, the carrying out of this must be impossible by ordinary means.

There is no known physiological antidote, for strychnine acts on the central nervous system, and the recommended *antispasmodics* such as *curare* act by paralyzing the motor nerve endings. However, theoretically curare should give rest to the muscles and possibly allow artificia respiration to be carried out effectually.

Post-mortem Appearances.—Pathologically nothing characteristic has been observed.

Analysis and Detection.—Fragments of the seeds above described must be searched for. The clean cut surface turns red on application of strong nitric acid.

False Angostura bark is usually sold as light brown twisted quills, about $\frac{3}{4}$ inch in diameter with many light coloured corky warts on the outer surface. The inner surface turns bright red with nitric acid and so this bark may be distinguished from Angostura and other quills.

Failing to find seeds or fragments, an extraction of the alkaloids by the Stas-Otto process (see p. 25) must be carried out with a preliminary physiological experiment on a frog.*

Strychnine Tests—

(1) Intensely bitter taste.

(2) A drop of concentrated sulphuric acid alone gives no colour, but the addition of a crystal of potassium bichromate or a granule of manganese dioxide will cause a play of colours, namely, blue, violet, purple and lastly red.

(3) A solution of iodine in potassium iodide gives an orange precipitate.

(4) Physiological action on a frog (see p. 19).

Brucine Tests—

(1) Bitter taste but not so intense as that of strychnine.

(2) A drop of strong nitric acid gives a bright red colour becoming yellow on warming.

Strychnine has been detected in the blood and urine, and may possibly be found in blood-containing solid viscera when failure has resulted from an analysis of the stomach

* It is affirmed by some authorities, that when Strychnine is contained in the alimentary canal and its contents, it will be extracted by Chloroform and Ether from the acid or neutral watery solution but not from the alkaline. I have, however, satisfied myself that this peculiarity does not exist when Strychnine is present in food-stuffs, vomit or urine; in such a condition it follows the rule (see p. 25), and in my experience although a small proportion is removed by the solvents, in the case of viscera and their contents, from the acid solution, yet a larger amount, and in a purer state, is extracted after rendering the solution alkaline.

contents. Like the products of opium, and unlike aconitine and daturine, it resists destruction by the changes of putrefaction.

THE OLEANDERS.

Nerium Odorum.

This is the sweet-scented oleander with white or pink flowers, and is common everywhere in India. (Vernacular, *Kaner.*) All parts of the plant are poisonous but the roots especially so.

The pounded root is used for suicidal and homicidal purposes and also as a cattle poison ; sometimes the root juice is smeared on a rag which is then thrust into the animal's rectum. The root is also said to be used as an abortifacient both internally and as a local application.

The poisonous action depends on the presence of the active principles *neriodorin*, *neriodorein* and *karabin.* Neriodorin and karabin appear to act on man like Digitalin, first stimulating the vagus and causing a slow forcible beat of the heart, then finally, through exhaustion, a rapid feeble action.

Karabin has also a spinal effect giving rise to strychnia-like convulsions.

Fatal Dose and Period are not known.

Signs and Symptoms.—Kaner is a gastric irritant and vomiting usually follows ingestion, accompanied by abdominal discomfort, and sometimes actual pain. The pulse is first slowed and later becomes rapid and weak. Respiration is hastened from the beginning.

Muscular twitchings and cramps soon set in, with later tetanic convulsions, which have the characteristic of usually affecting one side more than the other. Drowsiness followed by unconsciousness usually occurs early.

Treatment.—This must be symptomatic since no antidote is known.

Evacuation of the stomach and stimulation will be indicated, and if the convulsions are marked chloroform administration.

Post-mortem Appearances.—These are in no way characteristic, but there are usually congested patches in the stomach and small intestine.

Analysis and Detection.—This is very uncertain owing to the difficulty of obtaining the active principles or glucosides free from organic matter. These glucosides are more soluble in water than in ether, chloroform or other solvents and thus cannot be separated in any quantity from a watery solution by the Stas-Otto process. It is stated in text-books that from the acid solution this can be done, but such is not my experience. A fairly pure extract can be obtained if absolute alcohol be used several times (see p. 26) to get rid of as much organic matter as possible. This residue may be given to a cat on meat and a watery solution hypodermically to a frog (see p. 20). Chemical tests should be applied to the dry residue.

Neriodorin and Karabin Tests—

(1) *Strong sulphuric acid* with the mixed glucosides of the extract gives a chocolate colour, becoming, on standing, rich purple. The chocolate colour becomes crimson lake on exposure to nitric acid fumes.

(2) *Strong nitric acid* gives an orange colour.

These reactions are also readily given by the juice from the plant.

CERBERA THEVETIA.

This is the bastard or Yellow Oleander (Vernacular, *Pila kaner*). It is a very common plant in India and highly poisonous, the active principle being *thevetin* which, like neriodorin, etc., is a glucoside. All parts of the plant contain a milky juice in which is the glucoside. Its action resembles that of digitalin with sometimes a convulsant effect also.

The seeds are usually employed for suicidal and homicidal purposes, and also in some districts as a cattle poison and abortifacient. The fruit, which is three-cornered and about one and a half inches long, contains a nut of similar shape in which are two seeds.

Fatal Dose.—Probably three seeds will kill, since two have caused dangerous symptoms.

Fatal Period.—This seems to be usually from twelve to fifteen hours.

Signs and Symptoms.—Gastro-intestinal irritation is present with pain, vomiting and often purging. Headache and dizziness are common with pain in the throat and a dragging sensation in the tongue. The pulse is characteristic, being soft and slow, possibly only thirty or forty beats a minute ; it soon becomes weak and compressible, and in serious cases rapid, very weak and irregular. Death occurs from heart failure.

Treatment.—This is as indicated for oleander nerium poisoning.

Post-mortem Appearances.—There is nothing characteristic.

Analysis and Detection.—From organic matter extraction must be performed as for neriodorin, etc., and the same physiological tests carried out (see p. 19).

Chemical re-actions are given by the glucoside thevetin and also by the juice from all parts of the plant.

Thevetin Tests—

(1) *Strong sulphuric acid* gives a brown colour, changing slowly to crimson lake and lastly to green.

(2) *Boiling hydrochloric acid* (strength 1 in 4) turns a deep blue. This is characteristic.

The sulphuric acid re-action and play of colours is given by other active principles. For example, the resin extracted by ether from an infusion of *bhutapála* leaves affords a rich brown becoming purple and lastly greenish.

CERBERA ODALLUM.

This plant is allied to the other two oleanders and contains a similar active principle.

The fruit is globular, about two inches in diameter and contains one seed. The flower is white and star shaped.

INDIAN HEMP.

Cannabis Indica and **Cannabis Sativa** are the scientific terms of these plants. *Indian hemp* is probably never used for homicidal or suicidal purposes, but deaths from accidental overdose have been reported.

It is occasionally used as is dhatura for causing narcosis to facilitate commission of crime.

Three forms of the drug are in general use to procure pleasant dreams and sensations :—

Bhang consists of powdered leaves and smaller stalks ;

Ganja is the flowering tops, dried ;

Charas is the resin extracted from the green plant.

The two first are used to prepare drinks and sweetmeats ; of the latter a common form is known as *majun*, which sometimes also contains *dhatura*. Charas is taken as smoke.

It is generally believed that the majority of lunacy in India is due to over-indulgence in this drug.

Fatal Dose and Period are not known.

Signs and Symptoms.—The first stage is shewn by excitement with hallucinations and possibly laughing foolish talk. Homicidal violence is sometimes present. This is followed by a stage of *narcosis* with dilated pupils, vomiting sometimes follows the taking of bhang and tingling or numbness of the skin is often complained of. In severe poisoning there may be general anæsthesia. Recovery usually follows a deep sleep.

Treatment must be symptomatic.

Post-mortem Appearances are not characteristic.

Analysis and Detection.—Recognition of parts of the plant or the resin presents no difficulty, since the smell and taste are quite characteristic. Microscopically bhang and ganja shew fragments of green leaves covered thickly with curved, claw-shaped, sharp-pointed hairs ; this appearance gives a useful clue when examining food, drink, vomited matter or stomach contents. Extraction of

a resin with characteristic smell and taste can be performed with repeated treatment by absolute alcohol of the suspected material, but there are no chemical tests. Physiological experiments must be made by feeding a dog or cat ;—Narcosis with swaying of the head from side to side shews the presence of a poison which is almost certainly Indian hemp if microscopical and taste tests are also obtained.

COCAINE.

This is the alkaloid of the plant *Erythroxylon coca.* It is largely used in medicine and surgery, and in certain parts of India is taken as a stimulant and intoxicant. The "habit," or *cocainomania* is readily established.

The *hydrochloride of cocaine* is the usual form in which the drug is procurable. It is a white crystalline powder with the power of paralyzing peripheral sensory nerve terminations. It also acts on the central nervous system, and then causes general paralysis and anæsthesia. These properties are made use of, by applying solutions of the drug to mucous membranes, hypodermically and by injections into the lumbar spinal canal.

Eucaine, another derivative, is now very generally preferred for the above purposes.

Fatal Dose.—Hypodermically $\frac{2}{3}$ grain has caused death and by the mouth ten grains.

Fatal Period.—Ten grains by the mouth caused death in one hour, but from five to eight hours is probably more usual.

Signs and Symptoms.—At first there is a stage of stimulation and excitement, with rapid noisy speech and

exhilaration. A feeling of terror is sometimes present or noisy hysteria. With large doses this stage is followed by narcosis with paralysis of the centres of brain and cord, so causing slow depressed heart's action and weak respiration. General collapse is marked.

Alarming symptoms have not infrequently followed surgical use of the drug, and some persons appear to be very susceptible. Application to an exposed tooth pulp of a little cocaine has caused a wild hysterical condition.

Treatment must be symptomatic.

Post-mortem there is nothing characteristic.

Analysis and Detection.—From organic matter the alkaloid may be extracted in the usual manner and is soluble in ether.

Chemical Test ; (1) *Perchloride of gold* (10 grains to the ounce) solution gives a yellow precipitate which dissolves in boiling dilute hydrochloric acid, giving off a vapour which smells of benzoic acid.

(2) *Iodine* in potassium iodide solution gives a brown pink precipitate.

Physiological tests should be applied with the tongue tip and on a frog (see p. 19).

The tip of the tongue becomes at once numb and anæsthetic, the condition lasting for about half an hour only (cp. Aconite).

So far as is known there are no other commonly used poisons. Undoubtedly there are numerous other poisonous plants in India which are occasionally employed for criminal purposes. However, very little has been recorded

as to their effects and toxicology generally. Of such three only will here be briefly described :—

PLUMBAGO.

(Vernacular, *Lal chitra*).—The roots of this plant contain a poisonous glucoside *plumbagin*. The crushed roots have been used for homicidal purposes, and both internally and locally as an abortifacient.

Sometimes a root or twig itself is used as an abortion stick, or a piece of bamboo may be armed with a paste prepared from the roots. The root juice acts as a blistering fluid on the skin, and as an irritant poison when taken internally.

Analysis and Detection.—The roots are from $\frac{1}{4}$ to $\frac{1}{2}$ inch thick, dark coloured externally, but reddish internally.

From these alcohol will extract *plumbagin* which gives a red colour with caustic alkalies and also with lead acetate. If an alcoholic solution be used, the latter reagent gives a red precipitate, and this distinguishes plumbagin from the resin of rhubarb root.

MADAR.

Calioptris gigantea. All parts of the various madars yield an acrid irritant juice, which is made use of in native medicine, and also occasionally for homicidal purposes and as an abortifacient. It has been used as a cattle poison smeared on a rag.

It is said to have been used largely for infanticide in districts where that custom prevailed. The root bark is procurable in the bazars in short, flat curved pieces about

$\frac{1}{6}$ inch thick. The outer bark is soft and corky, and readily separates from the white middle cortical layer. The active principle seems to be a yellow acrid resin.

JEQUIRITY.

Abrus precatorius. Jequirity or *rătì* seeds contain a highly poisonous tox-albumen called *abrin.* They are made use of as a cattle poison and very rarely homicidally. Abrin is destroyed in the stomach, and only acts as a poison when introduced endermically or hypodermically.

A physiological test for the presence of *abrin* depends on the fact that a watery infusion will cause purulent *ophthalmia.*

ANIMAL POISONING.

Ptomaines.

Animal alkaloids or *ptomaines* are the result of bacterial action on animal nitrogenous matter, and certain of them are exceedingly poisonous. In consequence of the heat, and moist atmosphere of certain seasons ptomaines are readily produced in ordinary foods, such as meat, milk, butter, etc. The evil effects of some tinned meats may be due to the presence of this poison, and not to living bacteria or present putrefaction. In such cases the ptomaine has probably been formed before "canning" which process sterilizes the material but does not destroy the poison already formed.

Signs and Symptoms.—The usual effects are those of an irritant poison, whose action is usually delayed to

some hours after ingestion. In some cases dryness of the throat and dilated pupils are also present. The following is an instance of wholesale ptomaine poisoning : A party of British soldiers eat supper in the "institute," and in the night fourteen were attacked with purging, vomiting, and various degrees of abdominal pain. Two died, and the remainder after treatment recovered. The purging was violent and accompanied with tenesmus, while in several cases blood and slime were passed. *Post-mortem :* The mucous membrane of the stomach and intestines was intensely inflamed with patches of ecchymosis. No mineral or vegetable poison was detected in the viscera, but an extract of the stomach and contents injected into a cat's stomach killed the animal, with signs of gastro-intestinal irritation. The length of time after ingestion to illness varied from four to ten hours. The only common food partaken of by all fourteen seemed to have been milk.

Detection.—Several ptomaines give chemical reaction resembling certain vegetable alkaloids, but these have not the same physiological effect.

An extract of the suspected material can be injected hypodermically into a frog and into a cat's or dog's stomach and the effects noted. It must be remembered that in India putrefaction occurs so rapidly, that it is quite probable that ptomaines will be developed in food material or the deceased's viscera, vomit, etc., during transit to the analyst, who therefore cannot state whether the poison he finds was the poison causing illness or merely a later effect of bacterial action.

SNAKE VENOM.

The toxicologist is sometimes concerned with this when used as a *cattle poison.* Hankin drew attention to the use of snake venom, rectally administered, by the cattle poisoner. His description is as follows : A cobra is shut up in an earthen vessel with a banana and irritated. It bites the fruit, thus injecting its venom into the pulp, which is smeared into a rag, and thrust, by aid of a split bamboo, into the animal's rectum. Such rags are usually found *post-mortem* and should be dried, but never preserved in spirit, for this destroys the toxin. It is also asserted that sometimes the snake is made to directly strike the victim.

Detection.—The suspected rag, cut into small pieces, must be digested with half an ounce tepid distilled water for twelve hours. The liquid is then filtered, all being extracted by squeezing through muslin. Two drachms should be injected under the abdominal skin of a rabbit, which will die, with paralytic signs, in about twenty minutes, if active venom be present. If this occur, the remaining two drachms should be mixed with freshly obtained antivenine in about double the quantity, and injected into a second rabbit. Survival is considered as proof of the presence of the venom.*

The first rabbit may die in some hours' time. In this case death may be due to bacteria or their products or to some vegetable poison.

Aconite, oleander and madar are sometimes administered in this way. In such cases *alcohol* will extract the active principle.

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* I have in two instances obtained results as above described.

F. N. W.

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